IT TAKES GREEN TO GO GREEN:

AN ATLANTA-BASED EVALUATION OF EMPLOYER-PROVIDED COMMUTING INCENTIVES AS A METHOD TO OVERCOME WORK SITE CAR-DEPENDENCY

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Dedicated to Folgers Instant Coffee

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LIST OF SYMBOLS AND ABBREVIATIONS

DOT	Department of Transportation
FHWA	Federal Highway Administration
TDM	Transportation Demand Management
MNL	Multinomial Logistic Regression
SOV	Single-Occupant Vehicle
TOPICS	Traffic Operations Program to Increase Capacity and Safety
MPO	Metropolitan Planning Organization
TIP	Transportation Improvement Plan
TSM	Transportation System Management
OPEC	Organization of Petroleum Exporting Countries
HOV	High-Occupancy Vehicle
EPA	Environmental Protection Agency
CAAA	Clean Air Act Amendment
TCM	Traffic Control Measure
ISTEA	Intermodal Surface Transportation Efficiency Act
CMS	Congestion Management System
CMAQ	Congestion Mitigation and Air Quality
TEA-21	Transportation Equity Act of the 21st Century
MAP-21	Moving Ahead for Progress in the 21st Century
FAST	Fixing America's Surface Transportation
GRH	Guaranteed Ride Home
CTR	Commute Trip Reduction
HOT	High-Occupancy Toll
PAYD	Pay as You Drive
SCH	Seattle Children's Hospital
BART	Bay Area Rapid Transit

KP	Kaiser Permanente
VMT	Vehicle Miles Traveled
MARTA	Metropolitan Atlanta Rapid Transit Authority
GRTA	Georgia Regional Transit Authority
GCT	Gwinnett County Transit
TNC	Transportation Network Company
SP	Stated Preference
DCM	Discrete Choice Model

SUMMARY

Transportation Demand Management (TDM) is the concept of applying travel options and incentives to mitigate the effects of congestion through human travel behavior change. While traditionally applied in a municipal context, TDM has recently penetrated the corporate landscape, where employers utilize financial incentives and work place perks to achieve a commuter mode shift in their employee population that often results in financial benefits and increased employee well-being and productivity. A limitation in current employer-based TDM and within existing relevant literature is the arbitrary nature in which transportation alternatives and incentives are applied.

This thesis, and the incorporated Atlanta, GA employer case study, aims to further define the influence of travel-related behaviors within employee populations and the targeted methods of incentivization that could be applied to overcome alternative mode barriers. This research specifically evaluates the viability of carpooling and transit as alternative modes within the corporate commuting landscape, distinguishing between carpool driver and carpool passenger. A mixed-method survey approach is utilized to inform a multinomial logistic regression analysis that produces utility measures for socio-demographic and TDM-related variables. This work offers value to the field of corporate TDM by providing a contemporary reference point for TDM practitioners that can help them effectively target incentives to achieve their workplace commuting-related objectives.

CHAPTER 1: INTRODUCTION

American culture celebrates the car as a symbol of freedom, status and independence, and a principal element within the notion of the American dream. The growth of the personal automobile in the United States since 1900 has been tremendous, as car ownership rates now surpass 830 cars per thousand people, the highest ownership rate of any country in the world by a large margin (Davis & Boundy, 2019). The ubiquity of today's car use is a result of several years of singularly focused highway-oriented transportation planning, suburban flight, the advancement of fuel-efficient vehicles, and a lack of immediate dedication to society's shifting transportation needs. Though the transportation planning mindset has incrementally evolved to be multi-modal, many city landscapes remain largely sprawled, with low population densities, long travel trip distances, and inadequate availability of mass transit, walkways, or bike paths (Resnik, 2010).

The combination of the established car-centric culture and the inability to turn back the clock and undo several decades of solely highway-oriented investment has created a transportation network that remains dependent on the car. 82% of all trips are made using a private vehicle. The commuting population is especially reliant as 88% of commute trips are made using a private vehicle, usually during time-constrained morning and evening peaks (Federal Highway Administration, 2017). Existing road networks are overutilized and travelers experience significant congestion during most trips, which translates to a negative impact on the economy, personal quality of life, and the environment. With the uncertainty of the long-term effects of rapidly developing technology and research suggesting that over 70% of the world's population projected will live in urban areas by 2050, cities could become particularly susceptible to the destructive nature of urban gridlock.

Federal, state, and local municipalities and leaders have emphasized the use of Transportation Demand Management (TDM) to mitigate the effects of congestion through human travel behavior change. TDM, the concept that the Federal Highway Administration (FHWA) broadly defines as "providing travelers with effective choices to improve travel reliability", operates at the juncture of transportation planning and human psychology (Federal Highway Administration, 2004). The set of strategies aims to target the human behaviors associated with traveling modes and overcome barriers to entry for alternative modes of transportation. In recent years, TDM has penetrated the corporate landscape, where employers utilize financial incentives and work place perks to achieve a commuter mode shift in their employee population. The high-level societal benefits of commuter mode shift as it relates to congestion are transferable to the work place, where employers value financial savings associated with reduced vehicles on site and increased employee well-being and productivity.

The objective of this thesis is to assess the human behaviors associated with different aspects of commuting and study the implementation of various TDM initiatives as it pertains to the identified behavioral barriers. It evaluates the effectiveness of parking cash out, carpooling programs, and transit subsidies as viable strategies to incentivize alternative modes, focusing primarily on their ability to overcome established human inclinations toward single-occupancy vehicle (SOV) commuting. It analyzes, at a corporate work site level, employee behaviors related to different aspects of alternative travel as a function of descriptive characteristics like demographics, income, and current commuting environment. Using a stated preference survey released to a major employer in Atlanta, GA, this thesis attempts to quantitatively define the effect of specific variables identified as influential in human travel behavior. This research provides an important reference point for other corporate work places in determining the price point to achieve a desired mode shift within their employee population.

CHAPTER 2 describes the general state of transportation in the United States and how TDM is a viable concept for reducing car-dependency. It outlines the history of TDM, including major motivations for TDM development and growth, as well as the emergence of TDM concepts in transportation policy decisions. CHAPTER 3 breaks down the comprehensive nature of TDM into distinctive parts – land use management and policies, improved transport options, and pricing measures. It also introduces the concept of employer-based TDM. CHAPTER 4 provides case studies of successful employer-based TDM programs from three different unique work sites. CHAPTER 5 take a more in-depth look at the behavioral aspects of alternative commuting modes that produce personal commuting barriers for many employees. The section focuses on attitudes toward parking cash-out, carpool, and transit. CHAPTER 6 introduces the case study of the Atlanta, GA major employer, outlining the city and work site landscape characteristics. It also describes the methodology, results, and statistical analysis from the commuter behavior survey implemented on the employer campus. Finally, CHAPTER 7 recaps the impact and value of the research within the field of corporate TDM.

CHAPTER 2: BACKGROUND

The current American transportation landscape abides by the well-known scientific theory of "The Tragedy of the Commons", in which Garret Hardin, American ecologist and philosopher, posits that individuals inherently act in self-interest in the consumption or use of shared resources that are available to them. Often, the individual only sees the benefit to themselves and overlooks the detriment to the whole that is associated with over-use of the resource (Hardin, 1968). Hardin states "A self-interested rational actor will decide to increase his or her exploitation of the resource since he or she receives the full benefit of the increase, but the costs are spread among all users" (Western Washington University). While the theory has been widely applied to population growth and climate change, similar conclusions can be made about transportation challenges like congestion and its negative societal impacts. American culture has evolved to view roads as an available resource, and the increasing level of urban congestion is an indication that competition for that resource has made everyone worse off. The total cost of a motorized trip significantly exceeds the cost to the individual, resulting in the externalization of the cost to the community (Broaddus, Litman, & Menon, 2009). Hardin contends that the solution to the over-use of a shared resource is not technical in nature, which society yearns for, but rather a mutual coercion of the idea of human freedom, because "freedom is the recognition of necessity" (Hardin, 1968). In application to transportation, unless the total cost incurred by the travelers in each trip equals the total cost of the trip, urban congestion and car-dependence will remain a problem. Transportation demand management has emerged as a non-technical way to effectively address that problem.

2.1 Transportation Demand Management

The concept of Transportation Demand Management is nebulous, taking on a variety of situationally unique meanings and interpretations. It is fundamentally person-oriented, often described as “the flip side of infrastructure” (Mobility Lab, 2013). The underpinning concept within TDM is the provocation of behavior change in travel choices to influence people to use existing infrastructure more efficiently. This represents a paradigm shift away from traditional supply side congestion mitigation techniques. Rather than attempting to alleviate congestion through the widening of the roadway, which is proven to work only temporarily, TDM uses resources, incentives and policies to reduce or redistribute the demand for the network, more efficiently using existing capacity (Broaddus, Litman, & Menon, 2009).

Figure 1: Street Space Used Differently for 60 People (Source: Broaddus, Litman, & Menon, 2009)

While the conventional understanding of TDM primarily focuses on reducing SOV travel, contemporary interpretations take on a more holistic view. The interdisciplinary nature of TDM encompasses elements of urban planning, economics, sociology, marketing, engineering, information technology, and urban design, among others (Goddin, 2013). Only when all aspects are considered comprehensively does TDM become optimally effective as an instrument for economic, environmental, and social wellness.

2.2 Emergence of TDM in Policy

The first emergence of TDM as a visible concept occurred in the 1970's, when federal policy initiatives focused first on "improving the efficiency of the urban transportation system through operational improvements, and then incorporated concerns such as air quality and energy conservation into the transportation planning process" (Meyer, 1999). The conception of TDM can be directly linked to the combination of decreased federal infrastructure funding and two national oil crises that combined to threaten the American car culture. Although preceding local and federal initiatives can retroactively be viewed as TDM policy, during the time of implementation, the government stressed both congestion management and environmental considerations in different contexts. It was not until the late 1970's and 1980's that the initiatives converged to form TDM. However, while the vision of TDM became evident at that time, it took another decade and mounting concerns regarding air pollution and global warming for TDM to become a fixture in most municipal transportation policy initiatives (rideamigos, n.d.).

2.2.1 First steps

In 1964, in the wake of the enactment of the Federal Aid Highway Act of 1956, federal transportation infrastructure funding hit its peak at just over 0.5% of national gross domestic product (GDP). In the 10 years following, infrastructure grants decreased over 40% to just over 0.3% of national GDP (Davis J. , 2016). Figure 2 displays the historical trend of federal infrastructure funding, which contributed to an increased interest in alternative methods of transportation and TDM. Though transportation networks remained centered around the automobile for quite some time, this event sparked an adaptation in the intention behind transportation decision-making. No longer were transportation decisions solely about adding capacity to roads, but instead facilitated a more balanced approach to combatting congestion that included optimizing the existing network.

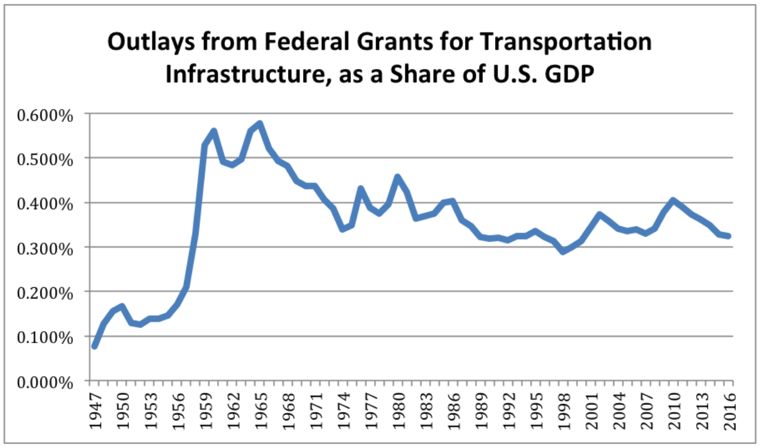

Figure 2: Federal Infrastructure Funding Trend (Source: Davis J. , 2016)

2.2.2 Congestion Management Initiatives

The first ostensible federal commitment to the optimization of transportation infrastructure came in 1966, with the trial establishment of a program called Traffic Operations Program to Increase Capacity and Safety (TOPICS), a program focused on traffic operation enhancements to improve the efficiency of urban arterials (Meyer, 1999). TOPICS was integrated into the 1968 Federal Aid Highway Act with the objective of "making traffic operation improvements on a systematic basis in accordance with an area-wide plan over a network of arterial and other major streets in the urban area...and is intended to maximize the efficiency of the existing street system" (Federal Highway Administration, 1969). During the same time, the federal aid transit program was in its initial phase of development. This program was dedicated to increasing the viability of mass transit as a regular mode of transportation (US Department of Transportation, 1971).

This commitment illustrates the changing mindset of transportation officials away from capacity-oriented expenditures. Throughout the 1970's, a myriad of regulations showed increased dedication to transportation management initiatives. The federal government passed regulation that created Metropolitan Planning Organizations (MPOs) for urban areas with populations over 50,000. "Congress hoped MPOs would help build regional agreement on transportation investments that would better balance highway, mass transit and other needs and lead to more cost-effective solutions to transportation problems" (Community Planning Association of Southwest Idaho). It was the responsibility of each MPO to create an urban transportation plan and transportation improvement plan (TIP) that incorporated both roadway projects and transportation system management (TSM) projects, including transit. It was communicated that projects with a multi-modal and TSM emphasis would be given priority. In 1978, U.S. Department of Transportation (DOT) further defined the role of TSM in urban transportation plans, categorizing TSM projects into (Wagner & Gilbert, 1978):

1) reducing demand (e.g., ridesharing),
2) enhancing supply (e.g., area-wide traffic signal timing),
3) degrading supply while reducing demand (e.g., take-a-lane high occupancy vehicle (HOV) facility), or
4) enhancing supply while reducing demand (e.g., add-a-lane HOV facility)

The creation of the TDM concept can be seen in the incrementally increased federal emphasis on controlling traffic through multi-modal transportation planning efforts.

2.2.3 Environmental Considerations

The 1960's and 70's marked the time when United States leaders' perspectives started to change regarding the role of air pollution in the future of the country. Research suggests that energy consumption and air pollution acted primary influencers in the adapted mindset toward congestion control. The idea of TDM was provoked by oil crises and air quality regulations in the 1970's.

2.2.3.1 Oil Crises

The 1973 oil crisis, the result of an Arab Organization of Petroleum Exporting Countries (OPEC) embargo on petroleum products against the United States, quadrupled the price of fuel domestically and highlighted both an American dependence on international fuel and private vehicles (Office of the Historian, n.d.). In 1979, social unrest from the Iranian Revolution damaged the Iranian oil industry, resulting in lower production and increased prices for consumers like the United States (Kettel, 2014). As America plodded through the 1970's, the overreliance on SOVs became apparent, and the increased awareness gave rise to a dedicated effort to reduce energy consumption, mitigate road congestion, and save people money (rideamigos, n.d.). Commuter carpooling became popular during those years, but it was quickly determined that American proclivity toward SOV travel was highly dependent on, and fluctuated with, fuel prices. As the price of gas stabilized at an affordable level in the 1980's and 90's, SOV usage continued to grow and TDM concepts faded from the forefront. It was not until the late 1990's, when global warming became a widespread concern, that TDM resurged as a viable strategy to reduce energy consumption and urban congestion.

2.2.3.2 Air Quality Initiatives

Aside from energy concerns related to skyrocketing oil prices, the federal government began to gain interest in air pollution control throughout the second half of the 20th century, and regulations quickly expanded to involve transportation components. The Clean Air Act of 1963 and its amendment in 1970 established procedures for monitoring the ambient air pollution and required the Environmental Protection Agency (EPA) to enact air quality standards for municipalities to meet. Any urban area that did not meet the established standards would have to develop an air implementation plan that could include stationary measures or transportation related measures. It was not until the 1977 and 1990 Clean Air Act Amendments (CAAAs) that demand management became a requirement in the implementation plans. The 1977 CAAA, through a joint DOT and EPA effort, required the development of transportation control measures (TCMs) within the air implementation plans for noncompliant urban areas (Environmental Protection Agency & US Department of Transportation, 1978). “TCM projects are essentially TDM projects because they also aim to reduce motor vehicle emissions by reducing vehicle trips, vehicle use, vehicle miles traveled, vehicle idling, and traffic congestion” (Ventura County, 2009). The 1990 CAAA expanded the role of the federal government and provided more detail about TCMs required in urban areas, a significant portion of which applied to demand management. Some of the demand management TCMs established by the 1990 CAAA are:

- Employer trip reduction programs
- Carpool and vanpool programs
- Telecommuting
- Alternative work schedules/compressed work weeks
- Transportation subsidies and incentives
- Marketing, advertising and education (Cambridge Systematics, 1996)

TDM has increasingly been integrated into the transportation planning process and become more concrete in federal transportation initiatives. In 1991, the Intermodal Surface Transportation Efficiency Act (ISTEA) established the requirements of all metropolitan transportation plans to incorporate demand management strategies "to enhance mobility including such things as ridesharing, pedestrian and bicycle facilities, alternative work schedules, high occupancy vehicle treatments, telecommuting, public transportation improvements, road pricing, and intelligent transportation systems" (Meyer, 1999). Importantly, ISTEA also required MPO's overseeing a population greater than 200,000 to create a Congestion Management System (CMS), a systematic process "for defining what levels of congestion are acceptable to the community, developing performance measures for congestion, identifying alternative solutions to manage congestion, prioritizing funding for those strategies and assessing the effectiveness of those actions" (Kentucky Transportation Cabinet, n.d.). The U.S. DOT required that if highway capacity projects were going to move forward in the planning process, the CMS must identify "other travel demand reduction and operational management strategies appropriate for the corridor, but not appropriate for incorporation into the single occupant vehicle facility itself" (US Department of Transportation, 1993). ISTEA also created the Congestion Mitigation and Air Quality (CMAQ) program, dedicated to fund transportation projects that align with 1990 CAAA identified TCMs to attain urban air quality standards (Meyer, 1999).

Since ISTEA explicitly defined TDM in federal policy initiatives, it has been further stitched into the federal transportation policy framework. Federal regulations like the Transportation Equity Act for the 21st Century (TEA-21) (1999), the Moving Ahead for Progress in the 21st Century (Map-21) (2012), and the Fixing America's Surface Transportation (FAST) Act (2015) all endorse the integration of multi-modal alternatives and TDM concepts into America's transportation planning process. Today, almost every major urban area has established TDM strategies to enhance multi-modal mobility through demand-side initiatives. The mindset has trickled down into the corporate environment as well, with more and more employers participating in commuting TDM practices.

CHAPTER 3: TDM APPROACH

To most effectively achieve the primary goal of reduced or redistributed SOV trips, a comprehensive TDM strategy should be implemented. One of the reasons TDM does not seem to have a significant impact on travel behavior is because TDM initiatives are implemented in isolation, rather than in an integrated approach. The literature relates an effective TDM strategy to a three-legged stool, unable to serve its purpose without one of its legs. The three "legs" of a comprehensive TDM approach are:

1) Land Use Management and Policies
2) Improved Transport Options, and
3) Pricing Measures.

The classifications are illustrated in Figure 3 (Broaddus, Litman, & Menon, 2009). While it is easy to implement measures in isolation, effective TDM lies at the intersection of all strategies.

There are two fundamental methods that all TDM strategies utilize. These are known as the "push" and "pull" methods, colloquially known as the "stick" and the "carrot", respectively. Essentially, the stick (push) is used to dissuade travelers from engaging in an undesirable activity, like driving their personal vehicle. The carrot (pull) is used to entice a traveler to engage in a desirable activity, like taking an alternative mode (Piatkowski, Marshall, & Krizek, 2017). Various measures can be applied at a federal, state, regional, or local government level, or they can be employer-based. Part of what makes a comprehensive TDM approach so difficult to implement is the coordination necessary between the different entities. The following section will go into further detail about specific measures that comprise the subcategories of TDM.

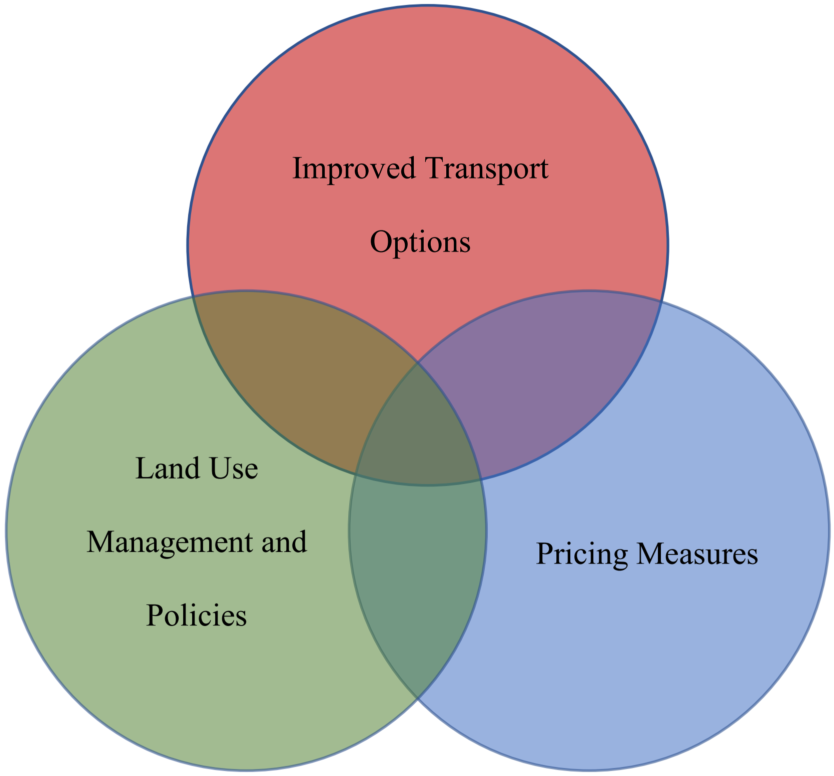

Figure 3: Effective TDM operates at the intersection of all three types of measures (Source: Broaddus, Litman, & Menon, 2009)

3.1 Land Use Management and Policies

Land use management encompasses the physical layout of cities and transportation facilities, which are significantly influenced by policy decisions. Responsible land use planning is integral to the overall effectiveness of TDM initiatives. Land use and transportation are often mentioned in the same breath, as two sides of the same coin, intertwined and with significant influence over each other. In the context of TDM, land use decisions relate primarily to the implementation of:

1) Smart Growth Planning, and

2) Responsible parking management decisions.

The strategies strive to combat sprawl, or the "decentralization of human occupancy" (Cornell College of Agriculture and Life Sciences).

3.1.1 Smart Growth Planning

Portrayed as the "antidote to the undesirable impacts of sprawl", Smart Growth aims to incorporate good planning practices into communities to improve transportation and housing options and improve quality of life (Cornell College of Agriculture and Life Sciences). In short, Smart Growth objectives include:

- High residential density;
- Neighborhood mix of homes, jobs, and services;
- Strength of activity centers and downtowns;
- Accessibility of the street network (Ewing, Pendall, & Chen, 2003).

The benefits of Smart Growth planning are well documented. A more compact, mixed use, multi-modal, and people-oriented environment gives travelers the opportunity to take alternative modes, resulting in positive transportation, environmental, and safety impacts. Smart Growth America conducted statistically significant analyses to represent the categorical differences between the 10 most heavily sprawled urban areas and the 10 least sprawled (Figure 4) illustrating the clear benefits that responsible land use management can create (Ewing, Pendall, & Chen). Because land use policies are principally related to the spatial layout of cities, municipal decision makers are the most heavily involved stakeholders. Local, state, and national governments use legislation and zoning regulations to drive land use policies that determine built environment changes. However, developers and employers can be involved in land use decisions in their choice of location and parking management decisions. Land use policy, under the jurisdiction of local governments, significantly influences travel choice and demand (SANDAG, 2012). Policymakers aim to achieve the identified objectives by facilitating development that promotes the use of alternative modes of transportation and reduced vehicle trips. That concept is known as location-efficient development.

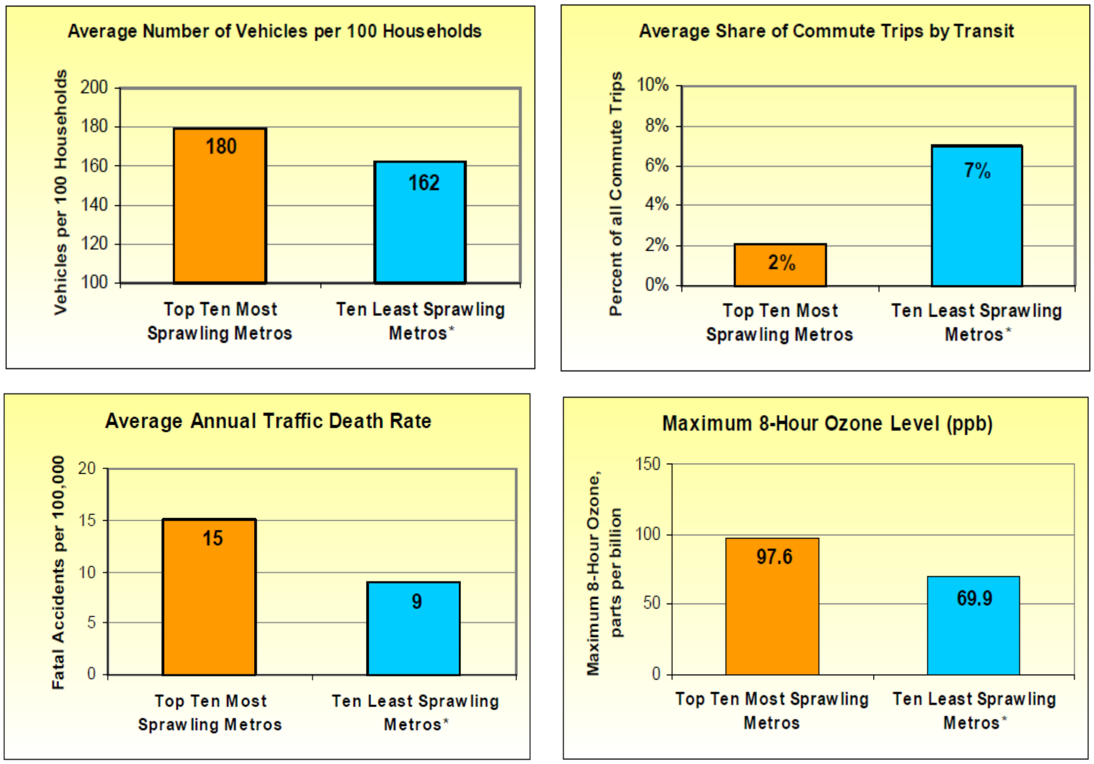

Figure 4: Comparison Between Most Sprawling and Least Sprawling Metros (Source: Ewing, Pendall, & Chen)

Location-efficient development follows the principles of Smart Growth by emphasizing accessibility and modal diversity through the use of responsible land use patterns (Litman, 2017). Such changes can occur through zoning reforms or through government designation of boundaries for the provision of public infrastructure. In turn, developers who choose to develop outside of those boundaries will incur the incremental cost of the additional infrastructure needed. Location-efficient development can take many forms, but primarily serves to maximize transit adjacent development and maintain an adequate jobs-housing balance with the goal of reducing trip generation rates and trip distances. The land use strategies are proven to have benefits for the users, developers, and the regional economy (Litman, 2017).

3.1.2 Parking Management

A primary objective within responsible land use planning is to reduce per capita automobile ownership and trip rates. Parking availability and cost significantly influence a traveler's mode choice. Parking management acts as a supporting mechanism for the location-efficient development discussed previously. It assumes that alternative modes are an option for people. Parking management strategies strive to push travelers toward those available alternatives through various techniques like unbundling parking, adapting parking minimums, and dynamic pricing schemes (Broaddus, Litman, & Menon, 2009). Within a land use context, parking management allows for increased flexibility in the use of land to create more walkable communities. Parking management strategies are heavily applicable to both the municipal and corporate landscapes, one of the unique Smart Growth principles that stretches across that boundary. Most land use decisions are exclusively a governmental function, but the ability to influence parking demand extends to corporate entities, with municipal governments retaining marginal influence through policy making responsibilities. The remainder of this research discusses parking management from an employer perspective, with the assumption of complete autonomy in parking pricing decisions. Further discussion can be seen in the pricing measures section (page 23).

3.2 Improved Transport Options

TDM strategy includes measures that center around the mobility of people, meaning the movement of people. Mobility assumes that "movement is an end in itself, rather than a means to an end" (Litman, Measuring Transportation, 2011). Improving mobility can be expanded to mean improving the availability, convenience, speed, security, or comfort of travel modes (Broaddus, Litman, & Menon, 2009). The provision of a variety of transport options encourages the use of alternative modes like walking, bicycling, transit riding, or carsharing and distributes or decreases the demand for transportation infrastructure. Most physical infrastructure improvements are made through local or state agencies, while the programmatic and service-related options can be made by both the public sector and private employer. Some major TDM strategies that improve transport options for travelers include:

- Physical infrastructure improvements – the allocation of public space is a constant push-pull between vehicle prioritization and other modes (Broaddus, Litman, & Menon, 2009).
    - Bicycle Improvements
    - Pedestrian Improvements
    - Transit Improvements
    - Bike/Transit Integration
    - Traffic Calming Measures
    - Bike & Ride or Park & Ride Facilities

- Programmatic or service-related Improvements
  - Alternative Work Schedules – Work schedule is determined by employer, but largely outside of traditional working hours
  - Flex Work – Employees can pick and choose the bulk of their own working hours
  - Transit Service Improvements – Improvement of frequency, reliability, or service range of transit options
  - Employer Shuttle Services – Employer-provided transit shuttles that enhance connectivity for employee commuters
  - Ridesharing Initiatives – carpooling or on-demand ridesharing initiatives that improve mobility (i.e. Uber, Lyft, employee-driven carpool platform)
  - Teleworking – Employer encouragement of working from home
  - Guaranteed Ride Home (GRH) – provision of employer-funded rides home for alternative mode users who need an emergency ride.

3.3 Pricing Measures

The final, and most traditionally understood aspect of TDM, is pricing. Behavioral economics and psychology research show that money is a powerful instrument in motivating behavior change in many different aspects of human life (Lee, Winters, Pino, & Schultz, 2013). The concept is evident in buy-one-get-one deals, loyalty programs, and happy hour specials, to name a few. The transportation landscape is no different, and several different incentives and disincentives have been applied within TDM initiatives, with the goal of reducing or redistributing SOV travel. Pricing measures can be implemented widely by public agencies, businesses and employers, in the form of both carrots and sticks. Some widely used pricing measures include:

- Congestion Pricing – a user charge for traveling on roads within a certain geographic range or time of day
- Fuel Taxes – At-the-pump charges that directly impact vehicle users
- High-Occupancy Toll (HOT) Lanes – Traffic lanes that are open to HOVs at no charge and SOVs that pay a demand-responsive variable fee
- Parking Pricing – Charging vehicle drivers to park their vehicle at their destination
- Pay-As-You-Drive (PAYD) Vehicle Insurance – Automobile insurance that is a function of miles driven rather than a flat monthly rate
- Commuter Financial Incentives – Encouraging the use alternative commute travel modes through the implementation of financial incentives

This research primarily focuses on the effects of commuter financial incentives and TDM initiatives within the corporate landscape. The concept of employer-based incentives and transportation programs is known as a Commute Trip Reduction (CTR) program. Sometimes local, regional, or state policies require employers to generate a CTR program, with consequences for the nonattainment of identified (Litman, Commute Trip Reduction (CTR), 2019). Companies generally establish a CTR program by setting clear goals and procedures related to their employee commuting behavior. Often, they will utilize external service providers to develop a comprehensive CTR program inclusive of carrots and sticks that influences the maximum number of employees. The travel impacts of CTR programs are often measured in terms of worksite mode split, vehicle trips, and average vehicle occupancy. Research indicates that in developed countries, employer CTR programs reduce peak-period car trips by 10-30% (Broaddus, Litman, & Menon, 2009). Reduction in automobile trips through CTR programs provides benefits to employees, employers, and the community. Employees at a worksite benefit from improved travel options and financial savings, along with the potential of improved well-being if their existing commute is burdensome. Employer benefits include reduced overhead costs, enhanced employee retention and recruitment, the provision of pre-tax employee benefits at a low cost, improved employee stress and productivity, and an enhanced corporate image (Winters & Hendricks, 2012). The community benefits from mitigated congestion through improved economic productivity, decreased pollution, and decreased transportation related costs resulting from reduced parking needs, increased alternative mode demand, and the support of efficient land use development (Litman, 2019).

While land use management, improved transport options, and pricing measures are all integral aspects of comprehensive TDM, employers can only truly influence the small scope in which they operate. The rest of this thesis strives to further the understanding of employer-based TDM practices, primarily affiliated with pricing measures and incentives for their employee commuting population along with some employee-focused transport options.

CHAPTER 4: EMPLOYER COMMUTE TRIP REDUCTION PROGRAM CASE STUDIES

4.1 Seattle Children's Hospital – Seattle, WA

The information in this section is obtained from two sources, "*Seattle's Transportation Transformation"* (Peterson, 2017) and "*How Seattle Children's Hospital Took the Lead on Healthy Transportation*" (Schmitt, 2015). The City of Seattle exemplifies the effectiveness of comprehensive TDM in both the municipal and corporate landscapes. With one of the most robust and balanced transportation systems in the country, and commitment to trip reduction from policy leaders down through individual citizens, the city has established itself as a leader in TDM practices. Seattle residents voted to tax themselves three years in a row, from 2014 to 2016, to expand urban transportation spending. The transformation seen in Seattle is evidence that a coordinated and comprehensive commitment is the recipe for success in TDM. A pillar of Commute Trip Reduction (CTR) in Seattle is the Seattle Children's Hospital (SCH), located two miles northeast of the University District in a relatively suburban environment. Having experienced a 72% drive-alone rate in 1995, SCH made massive improvements to lower that rate to 50% in 2008, 40% in 2010, and 38% in 2017, SCH demonstrates how effective TDM can be. In 2008, SCH renewed their commitment to reducing solo driving, outlining the ambitious goal to reduce SOV travel to 30% by 2038 in their comprehensive transportation plan. The accomplishment would be increasingly impressive given SCH's intention to expand to over double its 2008 capacity over the same period, with no intended additional parking structures. The permitting for the expansion is contingent on SCH meeting the identified transportation goals. Today, the hospital is well on its way, as it hosts over 6,000 employees and 1,000 patients daily, with only 1,400 parking spaces. SCH implements a myriad of TDM strategies, and if the 30% goal is reached, the hospital will avoid the construction of 500 additional parking spaces estimated to cost the about $20 million. Some of the TDM strategies deployed by SCH are:

- **Dynamic pricing for parking** – SCH requires all drive-alone travelers to pay for parking, except for families of a child patient. Parking is priced daily, with no monthly or annual parking passes available. Parking charges range from $2.25 to $10, depending on the time of day and length of stay. Peak commuting hours experience the highest rates.
- **Transit pass subsidies –** SCH fully subsidies employee transit passes for King County Metro. About 19% of employees utilize the subsidy.
- **Shuttle service**– As a solution to the last mile problem experienced by the suburban location of SCH, the hospital provides free and frequent shuttle service between the site and local transit hubs.
- **Parking cash-out -** In addition to charging for parking, SCH offers financial incentives for employees to use any mode other than their car. For any employee that does not drive alone to the campus, they receive $4.50 added to their pay check each day.

- **Vanpool program –** SCH, in coordination with King County Metro, offers a robust vanpool program to employees. The partnership allows employees to use the vanpool program at discounted rates. About 35 vans serve the hospital, and 19% of employees utilize the service. Vanpools are also granted free parking on campus.
- **Guaranteed Ride Home (GRH) –** For those commuters that choose to use any of the non-SOV alternatives offered by SCH, the hospital guarantees a free ride home in the event on of an emergency. This service is through a partnership with a local taxi service.
- **Bike commuting incentives –** SCH offers a free bike to any commuters who commit to bike to work two or more times per week. Additionally, an on-site bike shop provides free maintenance and gear to bike commuters. With about 25% of SCH employees living within three miles of the campus, biking comprises 9% of employee mode split, double the city average.

4.2 Kaiser Permanente Medical Center– Oakland, CA

The information in this section is primarily from two sources, "*Showcase hospital opens where health care system began"* (Kaiser Permanente, 2019) and "*Parking and bicycling information*" (2019). The Kaiser Permanente (KP) Oakland Medical Center, one of three KP medical campuses in the Bay Area, opened in 2014, and represents part of the $2 billion investment that KP has made to expand the northern California region's access to healthcare (Kaiser Permanente, 2014). The 12-story site has capacity for 349 beds and offers a suite of transportation programs aimed to reduce employee dependence on drive-alone commuting. The total campus is comprised of one hospital, seven medical office buildings and four parking structures. The KPCommuter programs and one-stop-shop dashboard "provides employees and patients with a wide range of transportation services, offering transit and vanpool subsidies, rideshare matching, preferential carpool parking, transit information distribution, a guaranteed ride home, bicycle parking and showers, shuttle buses, telecommuting, and prize drawings for programs participants. As a result, nearly one-third of the work force uses transportation alternatives an average of three days per week, which eliminates 48,000,000 miles of vehicle travel per year and a significant amount of automobile pollution" (Strompen, Litman, & Bongardt, 2017). The KP Oakland Medical Center is designated by the U.S. EPA as one of the Best Workplaces for Commuters. The TDM programs are explained in more detail below:

- **Parking –** The KP Oakland Medical Center charges for parking that exceeds 30 minutes in all the campus structures. As required by City of Oakland regulations, KP charges $1 for each subsequent 30 minutes, with a daily cap at $18.
- **Transit –** KP employees are eligible for a $30 transit subsidy with any of the local transit options (Bay Area Rapid Transit (BART), bus, train, ferry). Commuters qualify for the program by taking three or more roundtrip public transit or vanpool trips per week for a month prior, and by maintaining that standard during their membership.
- **Active Commuting –** In addition to ample bike parking on campus, KP offers a variety of active commuting perks to their employees. Various amenities include

active commuting locker rooms with showers, bike education classes, bike user groups, bike shop discounts, biking and walking route information, and a campus wide bike to work day. KP employees also benefit from a partnership with Ford GoBike, a bikeshare provider in the Bay Area. Employees receive a $25 discount ($124 down from $149) on annual memberships that allow them an unlimited number of trips up to 45 minutes.

- **Shuttles –** KP offers a free shuttle between the Oakland Medical Center and the MacArthur BART station in the area, about two miles. The shuttle has a 3 to 5-minute frequency during peak commute hours and an 8 to 10-minute frequency during off-peak hours. KP uses a mobile application for real-time shuttle arrival time predictions.
- **Carpool –** KP offers the opportunity for employees to join in an employer carpool program, for which they will receive free and preferential parking. Requirements to enroll in the program include sharing the vehicle with at least one other KP employee for more than 50% of the longest trip distance to and from work for three or more days per week, as well as reporting to work between the hours of 6 and 10 AM. KP allows enrollees to utilize an internal ride-matching platform to find carpool partners.
- **Vanpool –** KP offers a vanpool subsidy and free parking for any group of 7 to 15 employees who commute together in an employee-owned or leased van. The vanpool subsidy amount is not identified on the KPCommuter website.

- **Commute Trip Calculator –** Within the KPCommuter dashboard, employees can calculate their drive-alone costs, determined by travel mode, distance, fuel efficiency, and parking and insurance costs. The calculator outputs an employee's monthly and annual commuting expenses and their environmental impact. This type of feature increases the education and awareness of the KP commuting population.

4.3 Biotechnology Corporation – San Francisco, CA

Another west coast-based employer, described simply as an established biotechnology company in this work, boasts an impressive suite of TDM initiatives that contribute to their 42% alternative commute mode split. From personal interviews, details about the employer's campus characteristics and program and incentive structure were obtained.

The employer is well-established in both industry and location, having conducted biotechnology research for over 40 years in San Francisco. Though their employer-based TDM program is comparatively nascent, is has grown over its 10-year existence to include a robust set of commuting offerings, including company-owned busses, ferries, and vanpools, as well as an employee-driven carpool program. Despite currently boasting only a 58% SOV commute rate, the company is dedicated to achieving an SOV rate under 40% by 2023.

The need for an effective TDM program is primarily business driven for this particular employer. The campus population, spread across about 20 buildings in a 200-

acre campus that is integrated with other neighboring companies, totals 15,000 daily commuters (66% full time employees, 34% contingent workers). Despite the large number of employees coming to campus every day, the employer only offers between 4,000 and 5,000 parking spaces, which are free to employees. As is the case with several large corporations, complimentary employee parking is seen as an amenity and recruitment tool that is engrained in company culture. Driven by desires to avoid additional investment in parking, improve the commuter experience, and recruit and retain high-quality employees, the company has invested heavily in offering and subsidizing alternative modes of commuting.

- **Company-owned Buses –** The company supplements the San Francisco public transit system with a fleet of over 50 busses that serve 27 different routes and over 35 stops within the Bay Area. Additionally, the company offers ~15 intra-campus shuttles that provide employees with access to buildings across the 200-acre site. In totality, the bus/shuttle service garnered 1,132,207 boardings in 2018, an average of ~4,500 per day. The bus service is free to full-time employees and offered to contingent workers for $3 per trip (up to $6 per day). The company also supplements Bay Area public transit options by providing transit connector buses from their campus to two regional transit options (Caltrain and BART). This service is free to all workers and the general public.
- **Company-operated Ferries –** Because the campus is situated on the San Francisco Bay, water-based travel is an opportunity for many employees. The company

operated five ferries that provide access between the South San Francisco Oyster Point Marina and four other marinas. In 2018, the ferries provided 45,857 rides to employees. The ferry service is free to full-time employees and offered to contingent workers for $3 per trip (up to $6 per day).

- **Enterprise Vanpool –** The company partners with Commute with Enterprise to offer employees access to vanpools. While the vanpools are employee-driven, the company transportation manager helps with coordination. Drivers are offered $8 per trip ($16 per day) to lead a vanpool and are on the honor system. It is estimated that each vanpool averages four passengers and ~44 miles driven per day. There are currently over 65 vanpools consistently commuting to the campus every day, and vanpool comprised a total of 61,229 trips in 2018. The user feedback, from those employees who regularly participate in the program is favorable. Despite the positive results of the vanpool program, the employer intends to decrease the scope of the program to reduce redundancies with public transit services. The vanpool service is free to full-time employees and offered to contingent workers for $3 per trip (up to $6 per day).
- **Scoop Carpool –** The company has partnered with carpool provider, Scoop, to offer employee-driven carpooling options to commuters. While the program is relatively young (implemented in October 2018), feedback and uptake has been positive. The company offers various driver incentives through the app-based program, fully reimbursing the cost of rides for full-time employees and offering significant rider discounts to contingent workers. Additionally, the company has

extended the service to employees from neighboring companies, increasing their available partner pool. Carpool commuter are also offered preferred parking spots located in premium locations on campus (close to buildings or on the ground floor of parking garages). Since its inception 10 months ago, the company carpool initiative has provided 31,583 one-way trips.

- **Other Initiatives –** Aside from the primary offerings within the TDM program, the company fully subsidizes all public transit trips, allows up to five GRH trips per year per employee, and financially incents employees regularly to commute via walking, biking, or motorcycle.

CHAPTER 5: EMPLOYER-BASED TDM CONSIDERATIONS

Effective employer TDM programs employ the use of both demand-side and supply-side initiatives. For example, an employer who charges for parking will discourage SOV commuting, but unless there is an alternative transportation option, employees will have no choice but to drive to work. In contrast, an employer who engages employees on both sides, direct incentives or disincentives and alternative opportunities, will have the most impactful effect on commuter mode shift.

This section of the research explores specific aspects of both the demand-side and supply-side of TDM. It evaluates the concept of parking cash-out as a measure for reducing parking demand, and assesses the behaviors associated with carpool and transit commuting, generally the primary modal beneficiaries from a parking cash-out initiative. It is hypothesized, based on extensive research, that a holistic employer focus on demand-side parking reduction policies and supply-side alternatives and incentives is the most effective form of employer-based TDM.

5.1 Parking Cash-out

"In the beginning, the earth was without parking. The planner said, Let there be parking, and there was parking. And the planner saw that it was good. And the planner then said, Let there be off-street parking for each land use, according to its kind. And developers provided off-street parking for each land use according to its kind. And again the planner saw that it was good. And the planner said to cars, Be fruitful, and multiply, and replenish the earth, and subdue it, and have dominion over every living thing that moves upon the earth. And the planner saw everything he had made, and, behold, it was not good."

–Donald C. Shoup, "The High Cost of Free Parking." Chicago, IL: Planners Press, © 2005, p. 21

Donald C. Shoup, widely regarded as the “Godfather of Parking”, dedicated his career to proving that free parking contributes to the demise of cities. As a professor of urban planning at the University of California, Los Angeles (UCLA), Shoup published several works considered to comprise the gospel of parking policy, work that has changed the way city planners view the impacts of parking. He asserts that within a commuting context, free parking is the largest fringe benefit provided to employees in the nation, and it encourages commuters to drive alone to work (Shoup, The High Cost of Free Parking, 1997). Subsequent research has reinforced the concept that parking availability and pricing have significant effects on travel mode choice. From a commuting perspective, employer-provided parking, while seen as a perk to employees, minimizes the true cost of driving to the user and heavily subsidizes roadway traffic congestion (Transit Center, 2014).

As stated in previous sections, a person’s affinity toward and preference for SOV driving stems from the culturally established construct of the car as a symbol of freedom and status, infrastructure that incentivizes vehicle travel and disincentivizes alternative modes, and the increased utility offered to SOV travelers through the lack of adequately priced driving and parking measures. Litman asserts that due to the excess provision of parking spaces in the United States (2-off street and 1-2 on-street spaces per vehicle), there is a $0.12 per vehicle-mile cost associated with driving that is not incurred by the actual drivers. This rate, if charged directly to the drivers, would double the perceived cost of driving (Litman, 2019). Instead, the cost is spread out to all citizens in the form of increased rents and taxes. The cost of parking is never free, but rather incurred either directly or indirectly by the people. Research indicates that of the 95% of employees in the United

States who participate in SOV commuting, "only 5% pay full parking costs and 9% pay a subsidized rate, and parking is unpriced at more than 98% of non-commute trip destinations" (Litman, 2019).

There is a clear and direct relationship between parking price and travel mode choice. Research shows that even minimal parking charges can have an impact on travel patterns. A 2005 study found that price elasticities of vehicle travel rates as a function of parking price range from -0.1 to -0.3 (Vaca & Kuzmyak, 2005). This indicates that a 10% increase in parking costs correlates to a 1-3% reduction in vehicle trips. Another study found that increasing parking fees from $0.28 to $1.19 per hour (50th to 75th percentile) reduced VMT 11.5% and emissions 9.9% (Frank, Greenwald, Kavage, & Devlin, 2011). While the relationship between parking pricing and mode choice is significant, using parking pricing to return the true cost of parking to the driver is seen as unrealistic within many corporate environments because it eliminates the amenity and essentially punishes employees for using something to which they feel entitled (Shoup, 2005). Parking cash-out has been shown to be an effective alternative that employers and parking policy leaders can implement to reform their parking schemes and reduce their SOV commuting rate.

Parking cash-out is the inverse of a parking charge. Instead of punishing people for driving, the cash-out provides non-drivers with the equivalent value of a parking space for the day, rewarding them for not parking. Parking cash-out places the decision in the hands of the commuter, allowing them to utilize employer-provided parking or cash-out their parking subsidy and pocket the value. Parking cash-out raises the effective price of commuter parking without charging for it (Shoup, 2005). The effect on employee perception is prominent, revealing that there is an opportunity cost associated with workplace parking, while avoiding employee opposition normally associated with direct parking charges. A cash-out initiative unbundles parking from the employee benefit package, while maintaining the availability of free parking as a workplace perk to attract and retain talent.

5.1.1 Impacts of Parking Cash-out

Perhaps the earliest in-depth study of parking cash-out impacts occurred in California, where policy makers enacted legislation in 1992 that required a parking cash-out option for employers who fell within certain classifications. The law details that employers who are located in air quality nonattainment regions, employ over 50 workers, and lease their employee parking must offer employees the option to trade in their right to a parking space for the equivalent cash value of the space (Shoup, 1992). In 2013 statistics, the policy applied to over 55,000 employers in California (Weikel, 2015), though the Air Resources Board has historically taken a laissez faire approach to enforcement of the rule. In 1997, Shoup studied eight Los Angeles area employers that had a total of 1,694 workers, to assess the effectiveness of the parking cash-out legislation on employee travel behavior. Figure 5 illustrates the modal shifts of the aggregated employee population from all eight work sites. The impact of the cash-out initiative, for which the price of employee parking ranged from \$36 to \$165 per month across employers, is evident in the results. SOV commuting fell by 17%, while carpooling, transit, and active commuting (walking and biking) increased by 64%, 50%, and 33%, respectively. Additionally, commuter parking demand decreased by 11% (Shoup, 1997). In essence, parking cash-out, while framed as a reward for not driving and parking at work, is a transit or carpool subsidy. As the figure shows, transit and carpool are the biggest beneficiaries in terms of modal shift, from parking cash-out initiatives.

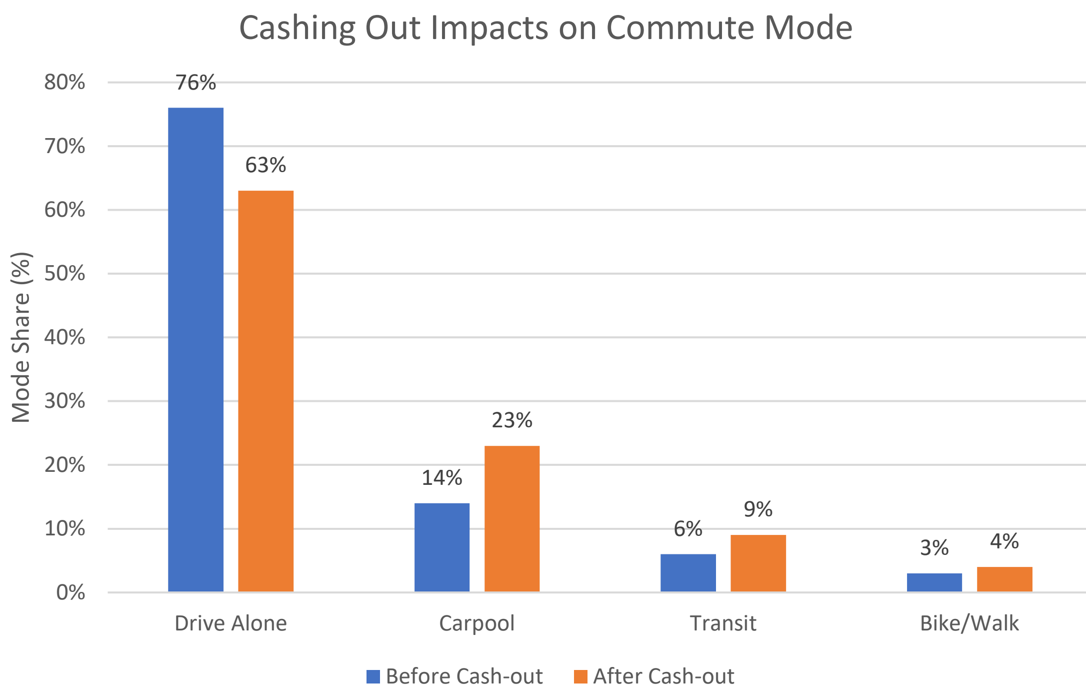

Figure 5: Parking Cash-out Impacts on Commute Mode (Source: Shoup, 1997)

While the results of Shoup's research are indicative of the mode share benefits of parking cash-out, it is important to realize that the level of effectiveness is situationally dependent on worksite setting and makeup. The level at which parking cash-out influences change in travel behavior is a function of urban density, alternative travel mode accessibility, and established cultural proclivities. Most importantly, it is a function of financial incentive; how much money the employer is putting back in employees' pockets. Figure 6 shows a study conducted by Modern Transit Society in 2006, which provides examples of parking cash-out programs at worksites with different geographic locations and employee populations, classified by level of public transportation accessibility (Modern Transit Society, 2006).

Location	Scope	Employees Affected	Financial Incentive ($1995/month)	Decreased Parking Demand
Group A: Areas With Little or No Public Transportation				
Century City District, West Los Angeles	3500 employees surveyed at 100+ firms	3,500	$81	15%
Cornell University Ithaca, NY	9000 faculty & staff	9,000	$34	26%
San Fernando Valley, Los Angeles	1 large employer (850 employees)	850	$37	30%
Bellevue, WA	1 medium-sized firm (430 employees)	430	$54	39%
Group Totals and Weighted Averages		*13,780*	*$47*	*24%*
Group B: Areas With Fair Public Transportation				
Los Angeles Civic Center	10000+ employees at several organizations	10,000	$125	36%
Mid-Wilshire Blvd., Los Angeles	1 mid-size firm	430	$89	38%
Washington DC Suburbs	5500 employees at 3 worksites	5,500	$68	26%
Downtown Los Angeles	5000 employees surveyed at 118 firms	5,000	$126	25%
Group Totals and Weighted Averages		*20,930*	*$110*	*31%*
Group C: Areas With Good Public Transportation				
University of Washington, Seattle Wa.	50,000 faculty, staff & students	50,000	$18	24%
Downtown Ottawa, Canada	3500+ government staff	3,500	$72	18%
Group Totals and Weighted Averages		*53,500*	*$22*	*24%*
Overall Totals and Weighted Averages		***88,210***	***$46***	***26%***

Figure 6: Parking Cash-out Impact Across Different Work Sites (Source: Modern Transit Society, 2006)

The study indicates that there is a wide range of per-dollar impact on mode shift, as no clear trend exists across public transportation access levels. The group-specific price sensitivities are as follows:

- Group A: Every $10 increase in financial incentive correlates to 5.1% decreased parking demand
- Group B: Every $10 increase in financial incentive correlates to 2.8% decreased parking demand
- Group C: Every $10 increase in financial incentive correlates to 10.9% decreased parking demand
- Total: Every $10 increase in financial incentive correlates to 5.7% decreased parking demand

Additional studies have taken the analysis a step further, classifying worksites by overall density and travel mode tendencies. A 2000 study in the United States evaluated the relative influence of a parking cash-out subsidy when compared across geographic density and level of transit access (Figure 7) (Litman, 2016).

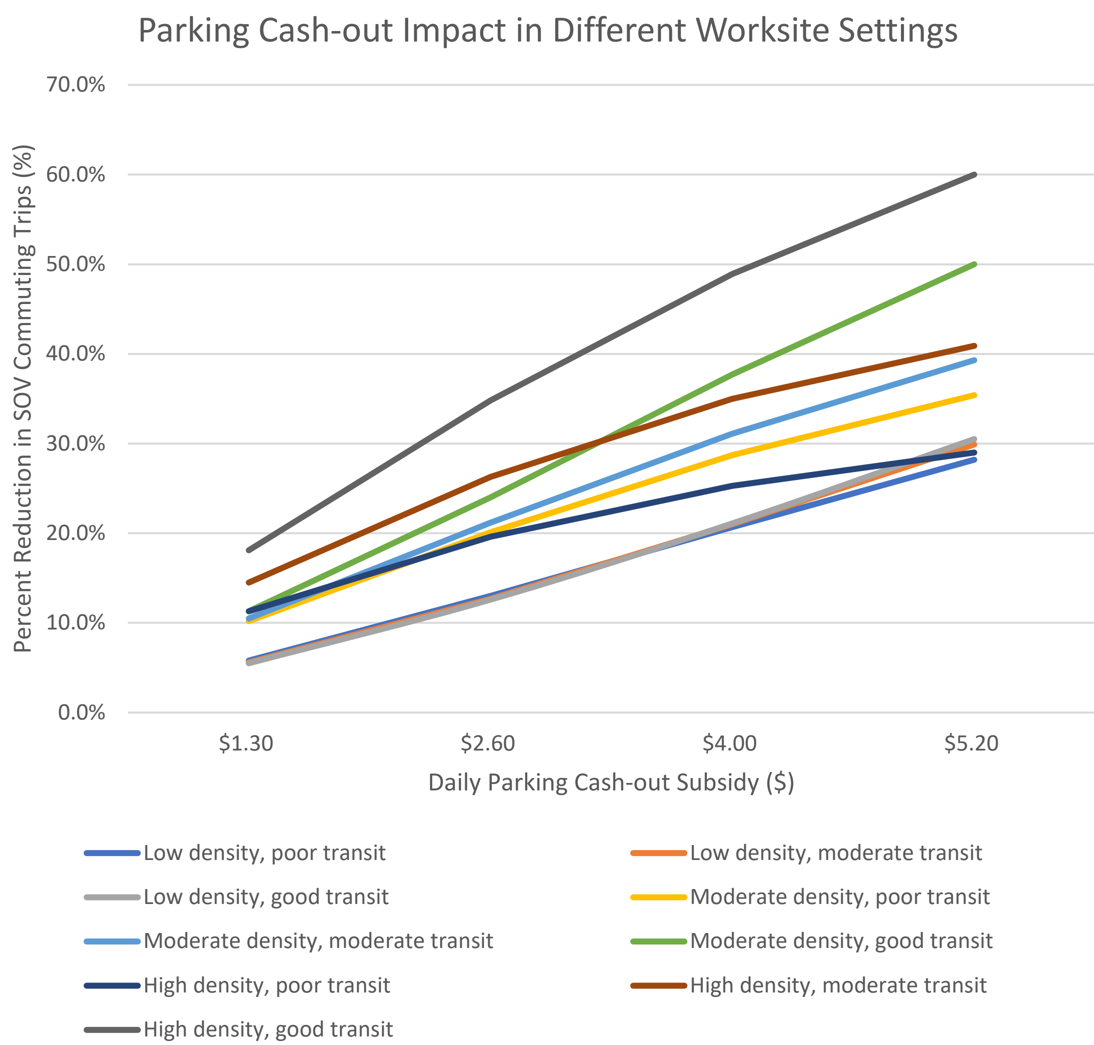

Figure 7: Parking Cash-out Impact Variability Across Density and Transit Access (Source: Litman, 2016)

In addition to the physical landscape in which a worksite is located, demographic characteristics can influence the level at which an employee participates in a parking cash-out program. Though relatively understudied when compared to the financial and geographical aspects of workplaces, employee gender, age, and income can be influential in determining program uptake. A 2006 research effort by the Center for Transport Research at Trinity College Dublin surveyed 388 employees about their potential behaviors toward a €4 per day parking cash-out scheme. The stated preference analysis determined the following:

- Age has a negative relationship with parking cash-out uptake
- Females are more likely to participate in parking cash-out than males
- Income has a positive relationship with parking cash-out uptake

The researchers also analyzed responses by the method of payment: one-time, annually, monthly, or daily[1]. The inferential analysis shows how much the mean of the dependent variable (parking cash-out participation) changes from a one-unit shift in independent variable (age, gender, income, car availability) while isolated from other influencing variables. Gender and car availability (having one or more cars available for use) are presented as binary parameters, meaning that the one-unit shift is the difference between a yes and a no. The regression coefficients and t-statistics for the analysis are presented in Figure 8 below (Watters, O'Mahony, & Caulfield, 2006). The results indicate that age is the only variable to show a negative relationship with cash-out participation, as increased age correlates to a decreased likelihood of cashing out. The other variables show

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[1] As a reference, €4 per day in 2006 was equivalent to $5.04 per day, from the exchange rate of 1.26. (Statista, 2019)

positive relationship, with car availability having the most positive effect, followed by income and being a female. This analysis shows that a young female employee with a high income and car access would be the most likely participant in a parking cash-out scheme.

Parking cash-out options

Parking cash out (giving up space for)	Coeff	t-Ratio
Substantial one-off cash payment		
Gender	0.389	2.1235
Age	−0.439	−2.0765
Income	0.457	13.793
Car available	0.585	5.494
Annual payment of €1300		
Gender	0.387	2.120
Age	−0.460	−2.179
Income	0.489	14.803
Car available	0.5746	5.409
Monthly payment of €100		
Gender	0.379	2.091
Age	−0.451	−2.150
Income	0.489	14.909
Car available	0.573	5.434
Daily payment of €4		
Gender	0.348	1.956
Age	−0.393	−1.906
Income	0.457	14.159
Car available	0.578	5.5

Figure 8: Parking Cash-out Variable Effects (Source: Watters et al., 2006)

5.2 Carpool

Carpool is one of the primary modes toward which commuters shift when they make the choice to take a non-SOV mode to and from work. Understanding the behavioral barriers associated with carpool, and striving to overcome them, are important to building the supply-side of corporate TDM. Overall, eliminating the reasons for employees to not take carpool adds to the attractiveness of the mode, reducing the financial incentive needed to motivate commuter mode shift.

The benefits of carpooling have been extensively studied since the oil crisis in the 1970's and is understood by most to be a sustainable transportation alternative that serves to mitigate traffic congestion and provide cost savings to users (Malodia & Singla, 2016)However, despite its inclusion in most municipal transportation policy, carpool, in practice, has experienced very limited uptake. Studies show that the lack of adoption is a result of various barriers that contribute to the negative attitude toward carpool.

Existing research classifies different influential carpool factors in various ways. For example, Gardner and Abraham, among others, separate behaviors toward driving into utilitarian and affective motives, and assert that behaviors toward carpooling can be assessed in the same way (Gardner & Abraham, 2007). Utilitarian motives, including travel time, financial cost, and convenience, are more attractive to users as the overall utility of the variable increases (Steg, Car use: lust and must. Instrumental, symbolic and affective motives for car use, 2005) (Steg, Vlek, & Slotegraaf, 2001). Affective motives relate to the self-expression associated with the travel, like stress, safety, power, freedom, and status

(Steg, Vlek, & Slotegraaf, 2001). While the different types of motives are usually studied in isolation, the evident complexity in their relationship highlights how convoluted motivational structures within travel mode choice can be (Mann & Abraham, 2006) (Reibstein, Lovelock, & Dobson, 1980). To satisfy the utilitarian and affective needs of an individual, the travel experience must have more overall benefit than cost, both in perceived efficiency and personal feelings. Perhaps the simplest way to visualize the breakdown of factors that influence carpool propensity can be seen in the (Neoh, Chipulu, & Marshall, 2015) depiction, seen in Figure 9.

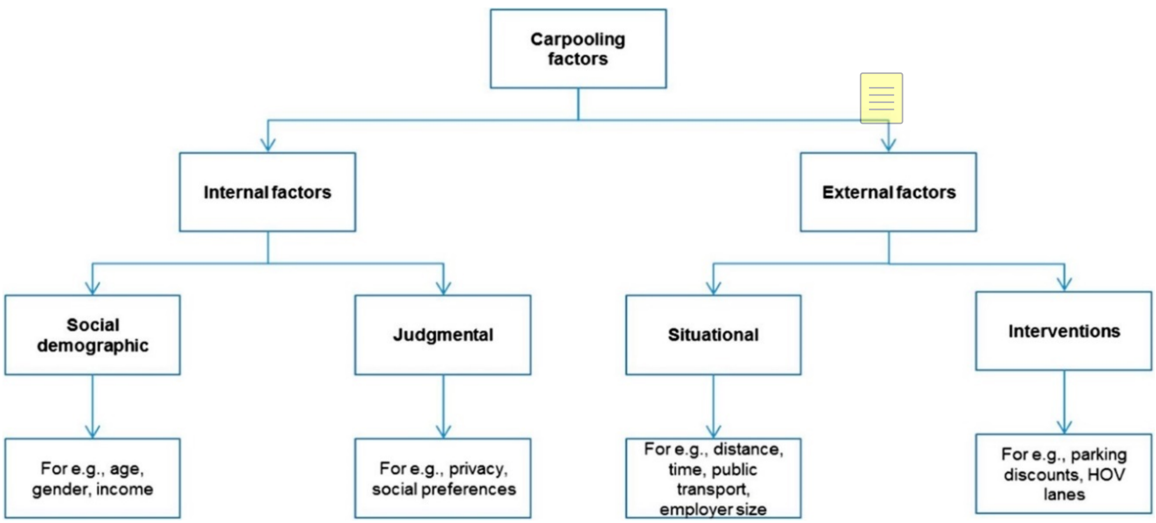

Figure 9: Classification of Factors that Influence Carpool Propensity - Source: (Neoh, Chipulu, & Marshall, 2015)

5.2.1 Internal Behavioural Influencers

Internal factors, which can also be described as the aforementioned affective motives, impact how an individual perceives the act of carpooling based on the feelings it evokes. Humans are emotional creatures, and overcoming a negative perception or feeling is a significant aspect of behavior change. Sociodemographic characteristics like age, gender, and income often suffice as proxies for more directly influential elements of mode choice behavior, however identified trends are sometimes inconsistent or complex (Brownstone & Golob, 1992). For example, although lower income individuals generally tend to have an increased proclivity toward carpool, higher income individuals tend to have higher car ownership rates, which correlates to their preference to carpool as a driver or passenger (Ferguson, 1995). Age tends to show a negative relationship with carpool propensity, likely linked to income (Longo, Glulio, Lorenzo, & Alessia, 2008). Females are shown to be more likely to carpool than males, which could be explained by an increased attention toward environmental issues (Neoh, Chipulu, & Marshall, 2015) or a smaller ego status. Some studies have shown that within non-carpooling populations, both males and females prefer to partner with females, while current carpoolers have no preference regarding partner gender (Levin I. P., 1982). Females have indicated an increased desire to be the passenger, while males prefer to be the driver (Levin I. P., 1982). Immigrant populations are more likely to carpool than native-born commuters, likely a response to the community ties that ethnic groups experience (Blumenberg & Smart, 2014)

(Blumenberg & Smart, Getting by with a little help from my friends...and family: immigrants and carpooling., 2010).

In contrast to the indirect relationship between sociodemographic characteristics and carpool behavior, judgmental factors deal directly with an individual's perception of carpool, based on how it impacts their natural tendencies toward privacy, convenience, freedom, power, or social compatibility (Steg, 2005). Furthermore, studies indicate that "subjective perceptions of the situation of carpooling (e.g. rapport with car mates, constraints to independence, status as a passenger or driver) are more important than the objective attributes of carpooling (e.g. cost, convenience, civic-mindedness)" (Oppenheim, 1979). Research shows that larger carpools decrease social comfort level for most users, perhaps related to the associated social pressure (Levin I. P., 1982). Morency (2006) concludes that contemporary activity rhythms of adults are less flexible than they used to be, meaning that they are more sensitive to the need for convenience and freedom. There is an evident relationship between a person's ability to control their surroundings and improved mental, physical, and emotional well-being, which can cause carpool to evoke a negative response (Gardner & Abraham, 2007). All these factors influence the perceived attractiveness of carpooling as a viable commuter strategy.

5.2.2 External Behavioural Influencers

External motives, including situational factors and interventional factors, relate to the utility-based influence of carpool programs. Carpool by itself is not an attractive mode to most, shown by individuals' natural propensity toward the privacy, convenience, and personal freedom of a personal vehicle. Situational factors, like travel distance, travel time, and proximity to carpool partners, also act as constraints to carpool participation, while interventional factors, like employer incentives (financial reward, guaranteed ride home (GRH), partner matching applications, or priority parking space) or high-occupancy vehicle (HOV) lane admittance, act as motivation for potential carpoolers to overcome their innate negative perception of the mode (Hunt & McMillan, 1997). Intuitively, situational factors like increased cost, as well as travel distance and time, which are influenced by proximity to carpool partners, decrease the overall utility of carpooling. However, a 1992 study in Southern California modeled that providing all employees with interventional benefits like reserved parking, ridesharing subsidies, GRH, and HOV lanes could still reduce SOV commuting by 11 to 18% (Brownstone & Golob, 1992).

Traditionally, carpool strategies have viewed instrumental variables, or external factors, to be the most influential determinant of carpool behavior. (Neoh, Chipulu, & Marshall, 2015) created a compilatory synthesis of past analyses (many of which are from the 1970's and 80's) into a comprehensive meta-analysis of carpool factors and their effect on uptake. Although the study was limited in scope, it concluded that "factors such as number of employees (0.42 effect), partner matching programs (0.42 effect), female (0.22 effect) and fixed work schedule (0.15 effect)" had strong effects on carpooling while "judgmental factors (such as the motivation to save costs) only exhibited small influence (< 0.1 effect)" (Neoh, Chipulu, & Marshall, 2015). While the analysis shows that individuals are seemingly practical in commute behavior, more recent studies have questioned the extent to which humans are logical and utility-oriented, instead hypothesizing that affective measures play a more significant role in a modern individual's attitude toward carpool (Lois & Lopez-Saez, 2009) (Redman, Friman, Garling, & Hartig, 2013) (Steg, 2005) (Mokhtarian & Salomon, 2001) (Steg, Vlek, & Slotegraaf, 2001). The disparity across various research results indicates that the behavioral barriers and perceptions that influence carpool uptake are understudied and inconsistent. There is a lack of quantifiable and empirically conclusive literature regarding the effect that culture, identity, social status, and emotions have on carpool behavior. The case study detailed in further sections of this thesis explores the understudied relationship between external and internal attitudinal factors that impact mode choice behavior, with attention toward quantifying the effect of specific interventional variables on employee travel behavior within transit and carpool commuting.

5.3 Transit

The public transportation system in the United States is seen as a sustainable transportation alternative for the future, highlighted by 77% of Americans indicating that they view it as the backbone of a multi-transit lifestyle (American Public Transportation Association, 2019). However, current public transportation systems are often characterized by unreliable and uncomfortable travel experiences, resulting in low ridership (Hester, 2016). Existing negative perception toward public transit is a result of the long-established car-centric culture and dependence, perpetuated by a public transportation funding gap that grows by ~$8 billion per year (Federal Highway Administration, 2015). Additional investment is the clear solution to reversing the low ridership experienced by many cities' public transportation systems, but the investment will be most effectively targeted with a comprehensive understanding of the existing perceived barriers associated with transit. This section explores the functional and affective barriers that contribute to the negative perception of public transit among different socio-demographic commuter groups and explores the role that employer-based TDM can play in overcoming those barriers.

Similar to carpool usage, a commuter's proclivity to take public transit is a function of their perceived utility of that mode change. Consumer economics theory tells us that a good is consumed if a rational individual's willingness to pay is higher than the cost of the good, a theory that is transferable to transit usage (Levin & Milgrom, 2004). Maximizing the perceived utility of commuters involves holistically addressing utility-based and behavior-based measures. However, while humans have historically been assumed to be rational decision-makers, recent studies have shown that, in fact, we are "predictably irrational" decision-makers (Markovits-Somogyi & Aczel, 2013). As a result, classical approaches to shifting mode choice are less effective than strategies that predict the relevant behavioral patterns of irrationality – a concept known as behavioral economics (Markovits-Somogyi & Aczel, 2013). This concept of irrational decision-makers creates complexity in assessing personal utility associated with travel behaviors, including transit. While the general set of external (nature) and internal (nurture) factors that influence transit patronage are well researched, the level of inconsistency across individuals is relatively understudied in existing literature. Taylor, Miller, Iseki, and Fink (2008) describe the "aggregate consumption of public transit service as a function of the collective characteristics of travelers, the physical and economic characteristics of metropolitan areas, the availability of substitute modes for travel, and the price, quantity, and quality of transit services." This evaluation focuses on the most TDM-applicable "nurture" motives between traveler characteristics and transit usage.

5.3.1 Price and Time Measures

Trip fare and frequency of service are heavily studied influencing factors of transit usage. Intuitively, in a vacuum, increased trip fare will decrease usage while increased frequency will increase usage. A 2008 study of 265 urbanized area transit systems found the relative influence of both fare and frequency (in terms of annual service miles per route mile). On average, a 78.9% decrease (from $0.95 to $0.20) in trip fare result in a predicted 119.7% increase (7.1 to 15.6) in per capita urbanized area boardings. Additionally, a 447.2% increase (from 2,340 miles to 12,803 miles) in service miles per route mile resulted in a predicted 135.9% increase (6.4 to 15.1) in per capita boardings (Taylor, Miller, Iseki, & Fink, 2008). Closely related to frequency of service is traveler's perception of travel time, which has been shown to have a significant effect on an individual's satisfaction. Rocky Mountain Institute estimates that an additional 10 minutes on a one-way commute has the same negative impact on job satisfaction as a 19% reduction in gross income (Keeton, Levy, & Karfs, 2018). While that study is not specific to transit, the same principles apply. Furthermore, that commute time influence has an increased effect when applied to perceived transit travel time. A Dutch study of 6,318 commuters found that travelers tend to over-estimate the public transit travel time by about 50%, meaning that the actual travel time is only about 2/3 as long as the perceived travel time, on average. The study links this partially to an inherent negative perception toward transit and partially to the potential for car users to have "consciously distorted subjective public transport travel times" (van Exel & Rietveld, 2010). Litman (2011) conducts travel time related analyses that compare transit travel times to in-vehicle travel times and wage percentages. He concludes that:

- Travel time can be valued as a percentage of typical per-minute wages earned. Determined values are 25% of wages when sitting, 50% of wages when standing, 100% of wages when in a crowded bus or train, and 175% of wages when waiting in unpleasant conditions.
- Transit transfers are valued at 5-15 minutes of in-vehicle travel time.

5.3.2 Reliability Measures

In addition to price, frequency, and travel time of transit service, the ability to trust the system is an influential factor in an individual's mode choice decision, especially for work trips. Carrel, Halvorsen, and Walker (2013) conducted a transit reliability behavior survey with 104 respondents to define the level to which specific aspects of reliability are important to commuters. Figure 10 displays the relative importance (1 = don't care, 5= very important) of various reliability measures. Additionally, Litman (2011) finds that each minute of delay from the published schedule is perceived as 3-5 minutes of in-vehicle travel time.

Aspect	Mean	Variance
Work Trips ($N = 104$, except where noted otherwise)		
Can make a connection the published schedule says is possible ($N = 25$)	4.950	0.050
Can walk up to stop and leave within 10 min	4.592	0.349
Don't have to wait more than 10 min to transfer ($N = 25$)	4.520	0.427
Trip takes the time specified in the published schedule	4.482	1.094
Each trip takes the same time	4.442	0.443
Can check real time information to find a departure within 10 min of desired time	4.413	0.944
Leaves at the time on the published schedule	4.253	1.093
Departs at same time every day	4.010	1.194
Not overly crowded	3.913	0.759
Can find a seat	3.375	1.091

Figure 10: Relative Importance of Transit Reliability Measures (Source: Carrel, Halvorsen, & Walker, 2013)

5.3.3 Travel Experience Measures

The on-transit experience has relative influence on the travel decisions of commuters. In the Litman synthesis (cited from (Douglas Economics, 2006)), he converts qualitative transit travel improvements to the corresponding fare value or time value for passengers. Table 1 displays the results. For clarity, the first row is saying that an average transit passenger would pay an additional 5.6 cents (in 2003) per minute of travel and accept an additional 0.38 minutes (23 seconds) of travel time for layout and design improvements to the train. These data are informative for transit providers and municipalities to estimate the influence specific improvements can have.

Table 1: Transit-related Improvements and Equivalent Fare or Time Value

Type of Train Improvement	Additional Fares (2003 Aust. Cents Per Minute)	Additional Onboard Time (Additional Time in minutes)
Layout & Design Improvements	5.6¢ (2.2%)	0.38
Cleanliness	3.8¢ (1.5%)	0.26
Ease of Train Boarding	3.2¢ (1.2%)	0.22
Quietness	3.2¢ (1.2%)	0.22
Train Outside Appearance	2.3¢ (0.9%)	0.15
On-Train Announcements Improved	2.3¢ (0.9%)	0.16
Heating & Air Conditioning	2.2¢ (0.8%)	0.15
Improved Lighting	1.9¢ (0.7%)	0.13
Smoothness of Ride	1.5¢ (0.6%)	0.10
Graffiti Removed	1.2¢ (0.5%)	0.08
Seat Comfort	1.1¢ (0.4%)	0.07

Overall, traveler behavior is difficult to gauge quantitatively, and often is presented with inconclusive or inconsistent results. From an employer perspective interested primarily in influencing employee commuting decisions, a comprehensive understanding of employer travel tendencies and mode barriers is pertinent to an effective TDM program. Parking cash-out, carpool and transit are TDM-related initiatives that invoke different behavioral responses among employees. With a better grasp on the general impacts of such strategies, practitioners now have a reference point they can use to anticipate or compare their specific program uptake. The next section evaluates an Atlanta, GA major employer's relevant work site behaviors to provide an additional and unique reference point for practitioners.

CHAPTER 6: CASE STUDY – ATLANTA, GA MAJOR EMPLOYER

The remainder of this research is intended to evaluate the potential effectiveness of TDM within the corporate environment, specifically at a major employer in Atlanta, GA. While the literature shows extensive research regarding employer-based TDM, there is limited attention toward financial incentives necessary to overcome specific behavioral factors that influence commuting decisions. While corporate cultures vary across companies, and commuting behaviors can vary significantly based both on the geographical characteristics of the city and the personal characteristics of employees in the workplace, the human element of transportation choices is generally applicable in a variety of settings. This case study adds valuable insight to the employer-based TDM discussion and contributes quantitative measures to deepen the understanding of employee commuting behaviors and alternative mode decision factors.

6.1 The Atlanta Landscape

Atlanta, the capital city of Georgia, is considered by many as the economic and transportation hub of the south. It is the most populous city in the state and the 9th largest metropolitan area in the nation with almost 6 million inhabitants (United States Census Bureau, 2017). Atlanta is well-known for its infamous traffic congestion, highlighted by the convergence of Interstate 75 and Interstate 85 in the heart of the city. Despite experiencing one of the worst commutes in the nation, travelers in Atlanta remain heavily car-centric. Atlanta's unique landscape, with no real natural geographic boundaries, contributes to expansive and sprawling development patterns, further impressing the culture of car-dependence. Suburban population growth, an inadequate heavy rail transit network, and a growing economy continue to exacerbate the congestion that the region has experienced for several years. Though municipal decision-makers recognize the need for improved transportation in the region, to date, governmental initiatives have been largely ineffective. The average one-way commute in the Atlanta metropolitan region is 31 minutes, 5 minutes greater than the nation's average (United States Census Bureau, 2017). Atlanta drivers travel over 170 million miles every year (ARC, 2016). In 2018, traffic congestion caused the average individual driver in Atlanta to lose 108 hours of time (10% worse than 2017) and $1,505 (INRIX, 2018). The level of car usage in the region translates to significant negative environmental, economic, and personal well-being impacts.

6.2 Background on the employer

The case study company is an established large corporation with a presence in over 200 countries worldwide. To completely understand the Atlanta campus workplace structure and operating dynamics present at the studied company, it is necessary to further delineate the types of employees that work on-site at the corporate headquarters. The headquarters is a mixed worksite, comprised of executives, associates, and contingent workers. The different designations correlate to different levels of company benefits, flexibility in the workplace and incorporation in the company initiatives, including the transportation options. See the brief descriptions below:

Associates -

Associates are employees of the major employer in the traditional sense. They make up the majority of company employees, receive company benefits, and are eligible to receive financial incentives for company initiatives. Associates will be referred to as either "associates" or "employees" for the remainder of this document.

Executives -

Executives are high-level company associates. They receive company benefits and are eligible to receive financial incentives for company initiatives. Executives have access to their own restricted parking structure. It should be noted that executives can be described as "executives" throughout the remainder of this document but remain a portion of the associate population.

Contingent Workers -

Contingent workers are contractors that are assigned to work on-site at a company office. They do not receive company benefits and are not eligible to receive financial incentives for company initiatives. Contingent workers can park on campus and use campus facilities like the cafeteria, gym, and shuttle service. Contingent workers will be referred to as "contingent workers", "independent contractors", or "contractors" for the remainder of this document.

6.2.1 Major employer office campus

The company's corporate headquarters campus is located in the urbanized area of Atlanta, Georgia, near the congested Atlanta I-75/85 connector, on a ~33-acre footprint comprised of four main office buildings, three multi-level parking decks, and various smaller buildings and surface parking lots. Approximately 5,800 employees (65% associates, 35% contingent workers) are assigned to the campus, but only about 3,800 of them physically arrive to campus on the average work day due to travel demands and a supportive telework culture.

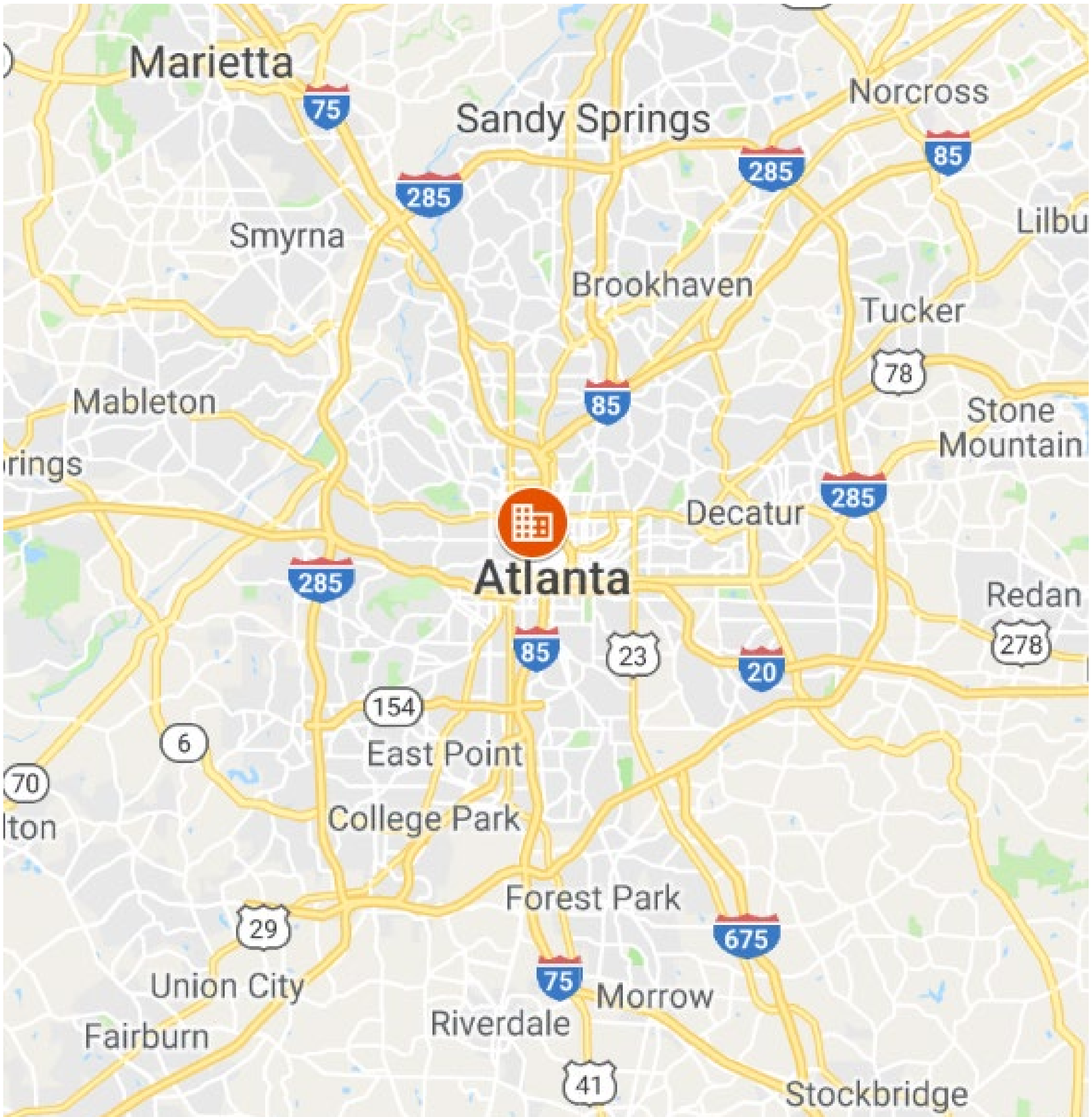

Figure 11: General Location of Case Study Employer (Source: Google Maps)

6.2.2 Parking

The study company owns all the parking structures on the Atlanta campus and offers complimentary daily parking to employees, contractors, and guests. The company's ability to offer free parking is seen as an amenity by employees and is used heavily as a recruiting tool for potential employees. In total, there are 4,399 parking spaces on campus, classified as non-executive employee parking, executive employee parking, guest parking, and other. See Table 2 for a detailed outline of parking availability on the Atlanta campus.

Table 2: Case Study Campus Parking Availability

Campus Parking Availability	
Employee (non-executive) Parking (associates and independent contractors)	3,737
Guest Parking	160
Executive Employee Parking	181
Other Parking	321
Total Parking	**4,399**

6.2.3 Commuter Programs

The Workplace Experience team at the company supports the primary business by focusing on creating a corporate environment that facilitates employee happiness and productivity in a cost-effective way. The dedication to employee experience extends beyond the campus boundaries and includes employee commuting. The company dedicates a complete team to the management of on-site and commute-related transportation programs. The transportation initiatives are driven primarily by business-oriented decisions, with a secondary focus on the company's environmental and community stewardship. The transportation program's principal objective can succinctly be defined as "make it easier for associates to get to work." To achieve that objective, the transportation coordinators manage several initiatives, categorized as:

- Parking Management
- Transit Programs
- Active Commuting
- Rideshare
- Electric Vehicle Management

6.2.3.1 Parking Management

The management of parking on campus primarily involves the monitoring of short-term and long-term parking demand for both employees and guests. The transportation team regularly assesses the present state of the parking on campus and makes decisions that influence the future demand. Free parking is established in the company culture in Atlanta, and company leadership has made it clear that they will not be charging for parking anytime soon. As a result, the transportation team uses other types of programs and incentives to manage the demand for on-site parking and encourage the use of alternative modes.

As mentioned previously, there are 3,737 employee parking spaces on the Atlanta campus. While the campus population routinely varies as a product of ebbs and flows in the company structure, the parking on campus regularly experiences upwards of 80% occupancy during workdays. In future plans, the parking-related company priority remains to create an enjoyable and complimentary employee experience, while simultaneously avoiding investment in additional parking structures. There are plans within the next five years to consolidate the campus population, which could eliminate some parking availability. As a result, the demand for parking supply could increase, further motivating the need for an effective TDM program.

6.2.3.2 Transit Programs

The company supports the use of public transit as a viable mode of transportation. With the campus located near the Metropolitan Atlanta Rapid Transit Authority (MARTA) rail network, many employees utilize transit to travel to and from work. The company offers pre-tax subsidies for several Atlanta transit agencies, including MARTA rail and bus, Georgia Regional Transportation Authority (GRTA), Gwinnett County Transit (GCT), and CobbLinc. Over the past year, about 250 employees regularly utilize the employer provided transit subsidy per month. Additionally, the company provides a dedicated employee shuttle between various destinations in Midtown Atlanta, including the Civic Center MARTA transit station, a major connecting point for regional bus routes. The employee shuttle serves the campus population at approximately 15-min frequency throughout each work day and experiences about 500 riders per day.

6.2.3.3 Active Commuting

The company offers several amenities intended to accommodate the needs of active commuters, essentially viewed as any commuter who does not drive their personal vehicle to work. Active commuting perks in the workplace include a dedicated locker room with showers and reservable lockers, dedicated bicycle parking on campus, and a monthly financial incentive attributed to meeting a minimum active commuting standard every month. The company facilitates a sense of community within the active commuting group and continually explores ways to improve their campus experience.

6.2.3.4 Rideshare

The company partners with a transportation network company (TNC) to provide rideshare benefits to its employees. In recognition of the evolving definition of mobility and aimed at providing non-SOV transportation options for employees, the rideshare initiative was started in 2017 and continues to be well-supported and valued by users. The benefit allows associates to receive discounted trips with the TNC for trips to and/or from the office campus on weekdays. In 2018, the program experienced a total of 13,500 trips made by employees, which can be estimated to indicate about 7,000 fewer cars on campus. In 2019, the company is actively evaluating the feasibility and value of an employee-driven carpool program for the office campus. In coordination with the analysis presented in this thesis, the transportation team will determine if such a program meets the needs of the employees and achieves the goals identified by the employer.

6.2.3.5 Electric Vehicle Management

In an effort to accommodate the needs of all types of commuters, the company installed 76 electric vehicle (EV) charging stations at various locations on the campus to enable EV users to top-off their vehicles during the work day. There are three different levels of chargers (1, 2, and 3), with varying levels of power. There are 67 Level 1 chargers, which provide a half-charge in 8 hours, 8 Level 2 chargers, which provide a half-charge in 4 hours, and a Level 3 "fast-charger", which provides a half-charge in 20 minutes. The chargers regularly experience over 75% utilization, monitored by the transportation team. The overall operating cost per charger averages $0.85 per day, translating to an estimated $1,400/month cost to the company. The company actively monitors the size and needs of the EV community on campus and anticipates future growth in the community associated with the rapid reduction in EV retail price.

6.3 Commuting Population

As mentioned previously, about 3,800 employees and contingent workers travel to the Atlanta employer campus each work day. While the precise mode split is not known, it is estimated that over 90% of the commuters use their personal vehicle to travel to and from work. The average commuting distance of the entire campus population is estimated to be approximately 20 miles one way. While the employer offers relatively flexible work schedules, most employees commute during the peak travel hours of 7:30 – 9:30 AM and 4:00 – 6:00 PM.

6.4 Commuter Behavior Survey

After extensive research of commuter travel behavior and choices, a case study was conducted at a major employer corporate headquarters in Atlanta, GA to evaluate employee commuting patterns and behaviors. With the knowledge that workplaces and cities have unique commuter sheds, as well as geographical and cultural characteristics, the deployed survey determines how the major employer's Atlanta commuting population views and is influenced by traditional barriers to alternative modes of transportation and quantifies to what extent those identified barriers can be overcome through employer provided financial incentives. The survey helps to generate a utility measure for several aspects of mode specific commuting trips that controls for commuting and personal characteristics. To achieve that end, the survey was developed as a joint effort between company representatives and Georgia Tech researchers, with three primary objectives in mind:

1) Determine employee-reported personal and commute characteristics
2) Identify factors that act as barriers to carpool and transit commuting
3) Assess the extent to which financial incentives can overcome specified barriers

6.4.1 Methodology

6.4.1.1 Procedure

The survey was deployed via email blast to 1,106 associates assigned to the corporate campus on May 20th, 2019. The sample was determined through a random sampling technique of the associate population on campus. Due to corporate policy, contingent workers are not eligible to be surveyed, and hence had to be filtered out. While that creates an inherent flaw in the analysis, the policy could not be avoided. Therefore, it was assumed that the associate population participating in the survey is representative of the entire campus commuting population. The 1,106 associates who received the opportunity to participate in the commuting survey were chosen as a random sample from the entire associate population, regardless of age, gender, pay grade, ethnicity, or any other characteristic. The sample represents 33% of the total associate population and approximately 21% of the entire campus population, inclusive of associates and contingent workers. Respondents were offered a small incentive, equivalent to about $3, to participate in the survey. The survey remained open for 14 days, until June 3rd, 2019. There were no email or other reminders administered throughout the duration of the survey. Out of the 1,106 associates surveyed, 230 completed the survey, a response rate of 20.8%[2].

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[2] There were two instances when recipients of the email survey invitation reached out to say that the invitation had been routed to their spam folder. It is unknown if this was the case for more of the sample.

6.4.1.2 Survey Design

This mixed-method research survey employs a combination of qualitative and quantitative measures intended to satisfy the three primary objectives. This approach fits the overall research because TDM decisions are both data-driven and inclusive of the human element. As stated earlier, the effectiveness of TDM programs is predicated on the ability to accurately predict how humans will react to the proposed measures or initiatives. Defining those behavioral tendencies and reactions is a major aspect of achieving the overall goal of TDM.

1) Determine employee-reported personal and commute characteristics

Determining personal and current commuting characteristics for employees involved a series of various question types. Personal descriptive characteristics like age, gender, income, and home address were requested, but not required due to strict corporate restrictions regarding personally identifiable information. Current commuting characteristics were determined through open-answer questions including distance and length of current commute, and categorical questions including primary and secondary mode of commuting travel.

2) Identify factors that act as barriers to carpool and transit commuting

This section of the survey was intended to give respondents a chance to report their primary reasons for why they commute in the ways they identified earlier in the survey. The questions were heavily informed by existing research about potential barriers to alternative modes and the impact of free parking on commuting behaviors. The survey uses three multiple-choice questions and asks respondents to choose their single primary barrier to both carpool and transit commuting. While the list of potential barriers is intended to be exhaustive, an "other" option is available. Additionally, respondents are asked to identify the level to which free parking influences their commuting decisions. The questions in this section are required.

3) Assess the extent to which financial incentives can overcome specified barriers

While the previous sections of the survey were intended to define who the study is investigating, the stated preference section of the survey strove to answer the question "how". How much does a respondent value any particular mode of transportation or any particular aspect of their commute? The survey used a discrete choice model approach that required respondents to choose their most preferred "package" given various categorical characteristics.

6.4.1.3 Stated Preference Survey Design

To investigate respondents' proclivity to use SOV, carpool, or transit, a stated preference (SP) survey was administered, where respondents were asked to "choose the option that they would most prefer in the future". The available packages were 1) Personal Vehicle Driver, 2) Carpool Driver, 3) Carpool Passenger, and 4) Transit Rider. The parameters that were varied within each package included 1) Financial Incentive, 2) Additional Travel Time, and 3) Matching Characteristics. The range of levels for each attribute were identified from existing literature about what thresholds exist in changing travel behavior. The package options created scenarios where respondents could weigh the relative benefit perceived from a combination of an employer-provided financial incentive, additional travel time, and carpool matching methods against the characteristics of a personal-vehicle commute. Respondent choices, and the subsequent analysis with personal characteristics, determine the effect of each variable on an individual's commute behavior, informing employer transportation coordinators of the most effective combinations of attributes needed to convert target audiences to alternative commute modes. The development and analysis of this section are explained later in the document.

6.4.2 Results

Of the 1,106 people invited to take the survey, 230 responded in completion, representing a response rate of 20.8%. While such a response rate is slightly low for the study employer, this level of detail has not been implemented before on the campus. 83% of respondents completed the survey within 24 hours, 93.5% completed it within a week, and the remaining 6.5% finished it in the second week of administration. Demographic questions about income, gender, and age were asked, but not required for respondents to complete the survey. The results are presented below.

6.4.2.1 Income

Respondents were asked to select within which range of yearly salaries they belonged. 95.2% (219/230) of survey respondents completed this optional question. The raw count of survey respondents within each reported salary range are seen in Table 3:

Survey Respondent Salary Ranges. The percentage-based results are shown below in Figure 12 and compared to the work site employee distribution in Figure 13. The salary distribution of the sample exhibits a similar trend to the age distribution when compared to the entire employee population on campus. While the lowest salaried group (< $60,000/year) was relatively accurately represented, the mid-salary segment of the population ($60,001/year - $150,000/year) was overrepresented by about 7% and the highest earning employees (> 150,000/year) were underrepresented by about 6% in the survey results. Similarities in the comparative trends between the age and income reinforces the intuitive concept that age and income are positively correlated.

Table 3: Survey Respondent Salary Ranges

Salary Range ($)	Number of Survey Respondents
< $60,000 per year	10
$60,000 - $90,000 per year	46
$90,001 - $120,000 per year	52
$120,001 - $150,000 per year	50
$150,001 - $180,000 per year	29
> $180,000 per year	32
Total	**219**

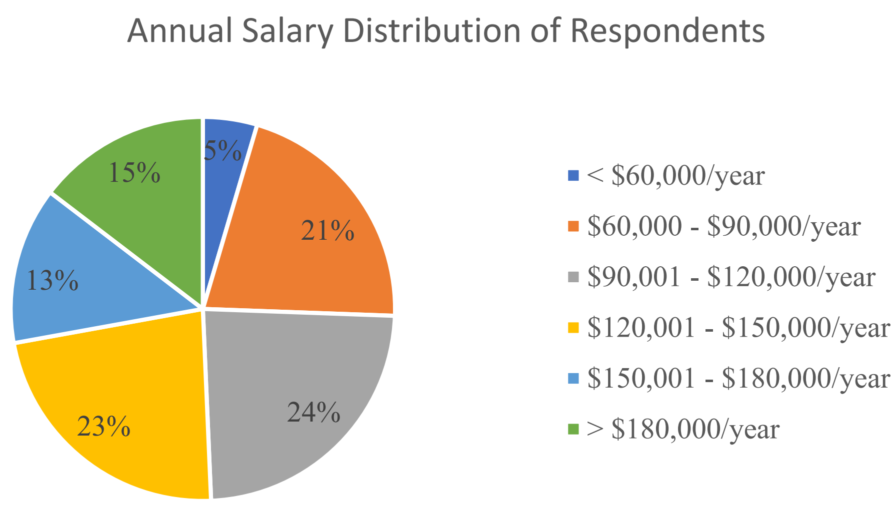


Figure 12: Annual Salary Distribution of Survey Respondents

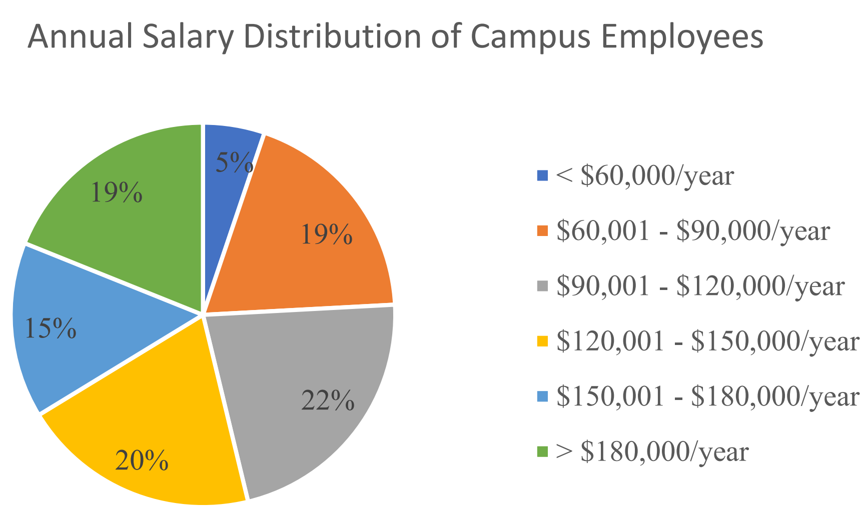


Figure 13: Annual Salary Distribution of Campus Employees

6.4.2.2 Gender

Respondents were asked to identify as either male or female. 93.5% (215/230) of survey respondents completed this optional question. 122 of the respondents identified themselves as female, while 93 respondents stated that they were male. Compared to the campus-wide population, females were underrepresented in the survey respondents by about 4%, while males were overrepresented by the same amount (see Figure 14 and Figure 15).

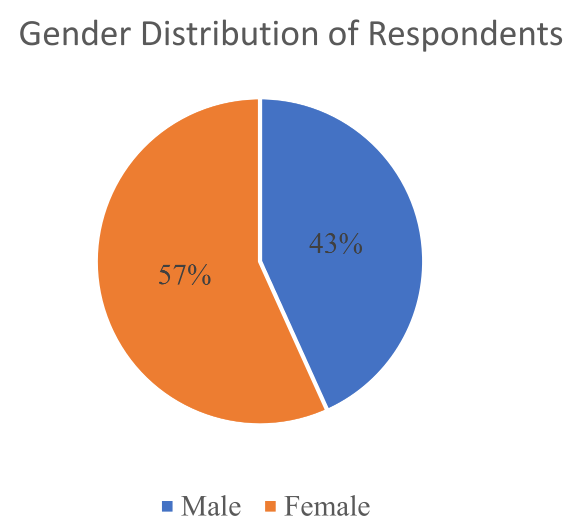


Figure 14: Gender Distribution of Survey Respondents

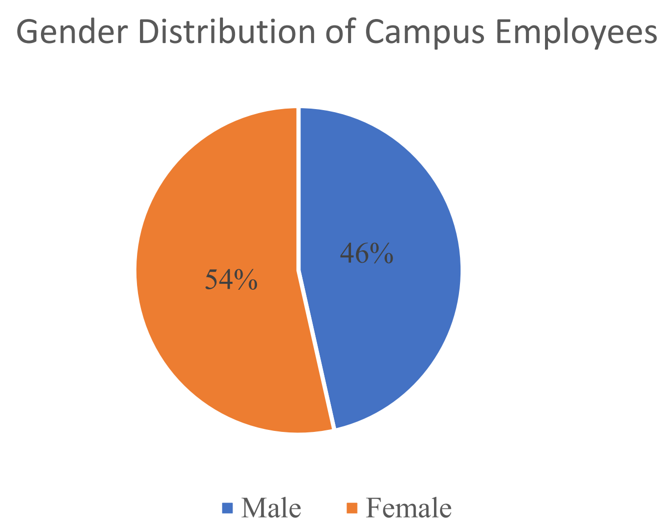


Figure 15: Gender Distribution of Campus Employees

6.4.2.3 Age

Respondents were asked to identify with range of ages they belong to. 97.8% (225/230) of survey respondents completed this question. The number of respondents in each age range are shown in Table 4. The results, presented in Figure 16 and Figure 17, when compared to the campus age distribution, show that the young population (< 25 years old) was generally accurately represented, middle-aged employees (25 – 45 years old) were overrepresented by about 10%, and older employees (> 45 years old) were underrepresented by about 9%.

Table 4: Survey Respondent Age Ranges

Age Range	Number of Survey Respondents
< 25 years old	4
25 – 35 years old	67
36 – 45 years old	70
46 – 55 years old	62
> 55 years old	22
Total	**225**

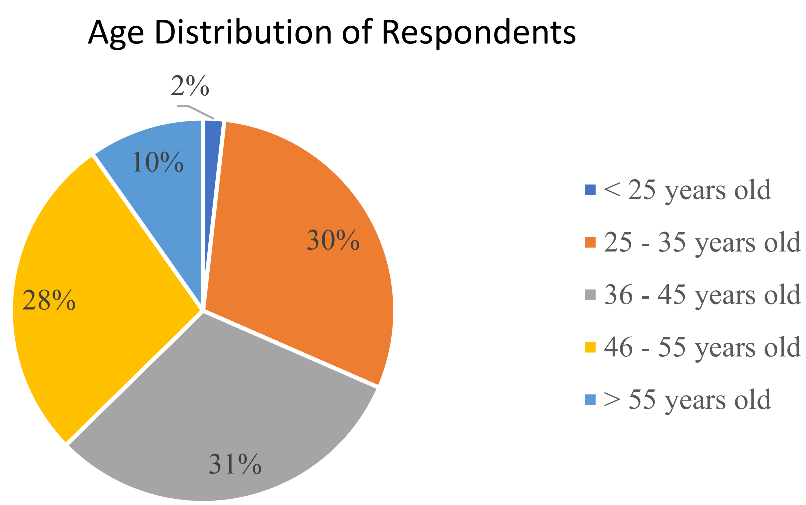


Figure 16: Age Distribution of Survey Respondents

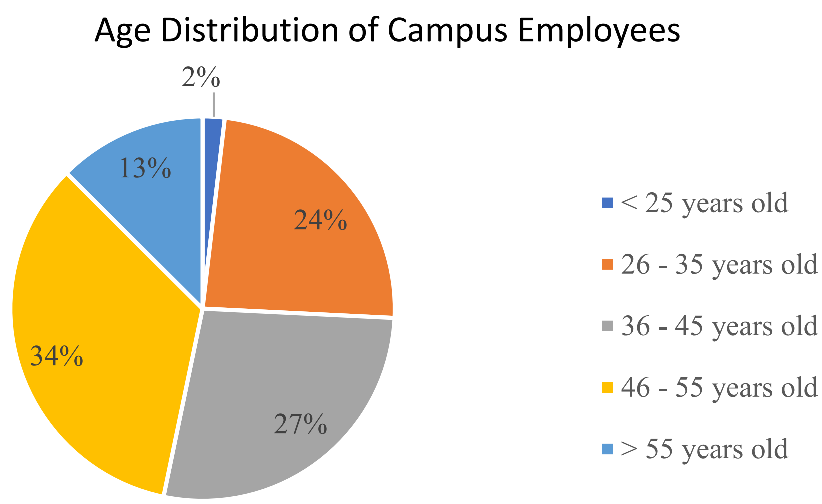


Figure 17: Age Distribution of Campus Employees

Table 5 displays the income, age, and gender relationships between survey respondents and the entire employee population on the study campus. As shown by the Chi-Square Goodness of Fit Test, the survey responses were a representative sample of the actual employee population.

Table 5: Survey Respondents and Employee Population by Category

Socio-demographic Category	Survey Respondents (N = 219)		Employee Population (N = ~3800)		Chi-Square Goodness of Fit Test
Income	N	%	N	%	X^2 = 4.396 , 5 d.f., p = 0.494
< $60,000/year	10	5%	10.95	5%	
$60,000 - $90,000/year	46	21%	41.61	19%	
$90,001 - $120,000/year	52	24%	48.18	22%	
$120,001 - $150,000/year	50	23%	43.8	20%	
$150,001 - $180,000/year	29	13%	32.85	15%	
> $180,000/year	32	15%	41.61	19%	
Age	Survey Respondents (N = 225)		Employee Population (N = ~3800)		X^2 = 9.139 , 4 d.f., p = 0.058
	N	%	N	%	
< 25 years old	4	2%	4.5	2%	
25 - 35 years old	67	30%	54	24%	
36- 45 years old	70	31%	60.75	27%	
46- 55 years old	62	28%	76.5	34%	
> 55 years old	22	10%	29.25	13%	
Gender	Survey Respondents (N = 215)		Employee Population (N = ~3800)		X^2 = 0.652 , 1 d.f., p = 0.419
	N	%	N	%	
Male	93	43%	98.9	46%	
Female	122	57%	116.1	54%	

6.4.2.4 Commuting Characteristics

6.4.2.4.1 Mode Split

The mode split results for the administered survey are presented in Figure 18. 81.9% of the 230 respondents identified their primary commute mode as drive-alone. When compared to averages in the Midtown and Downtown Atlanta neighborhoods, the site-adjacent municipalities, the drive-alone rate for the study employer indicates a significantly heavier reliance on personal vehicles.

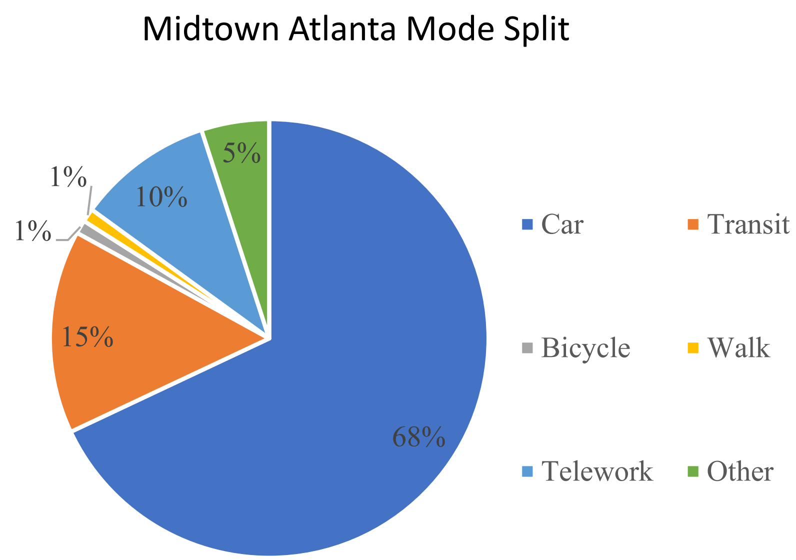


Figure 19 and Figure 20 show mode splits for both Midtown Atlanta and Downtown Atlanta, respectively.

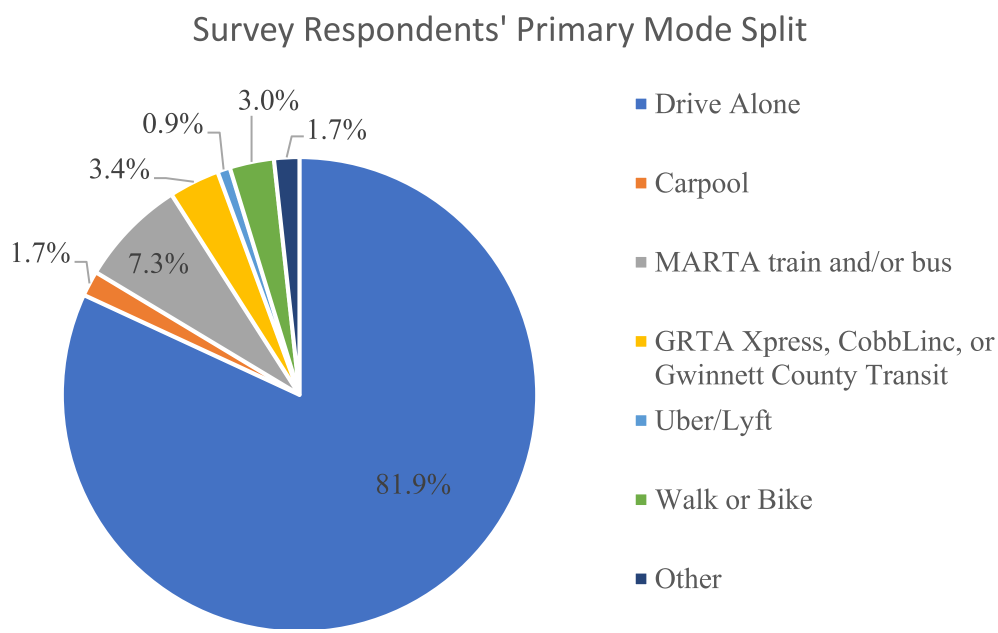


Figure 18: Mode Split of Respondents

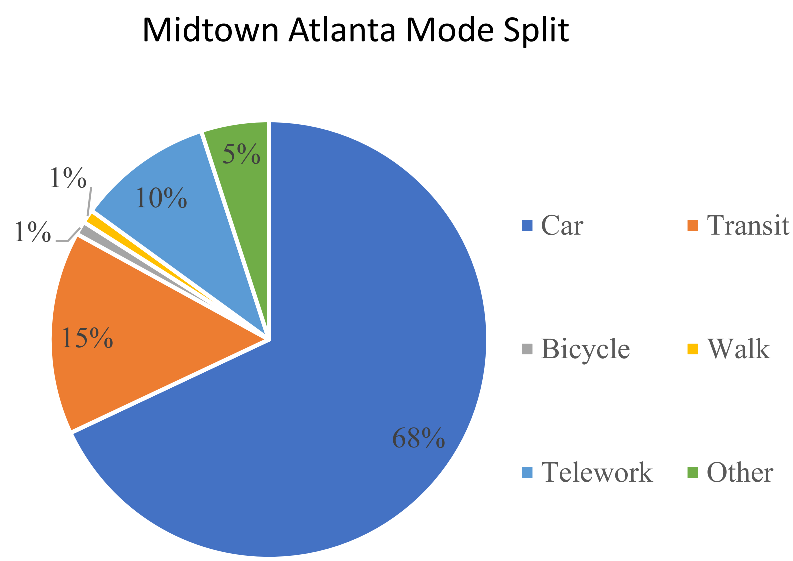


Figure 19: Midtown Atlanta Commuting Mode Split (Source: Midtown Alliance, 2017)

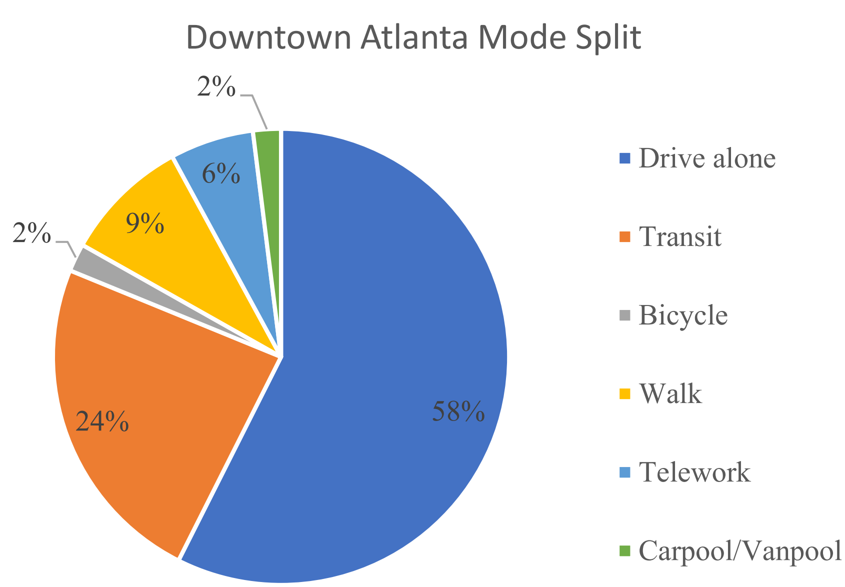


Figure 20: Downtown Atlanta Commuting Mode Split (Source: Atlanta Downtown, 2018)

It should be noted that the Midtown and Downtown data, obtained from the most recent transportation plans, includes different commuting categories than the published survey. The reference studies incorporate working from home as a commuting mode, whereas this research is solely interested in the physical act of commuting. If one were to eliminate the work from home category from the reference studies, car commuting would comprise 75.6% of Midtown commutes and drive-alone commuting would comprise 61.7% of the total Downtown mode split. This "adjusted mode split" can be applied to other commuting modes too. While for drive-alone behavior, an apples-to-apples comparison is only possible for Downtown (because the Midtown Atlanta Transportation Plan did not assess carpool usage), it can be inferred that the study employer has a higher rate of drive-alone commuting than the surrounding areas. While the carpool commuting rate of the study campus aligns with the Downtown Atlanta rate, there is disparity in the transit usage rates. The employer survey indicates a 10.7% (bus and rail) mode split for transit, while the adjusted Midtown and Downtown analyses show 16.7% and 25.5%, respectively. The significantly lower transit commuting rate can be correlated to the distance of the work site from MARTA rail. The campus, while transit accessible, may not be located within the preferred walkable distance for most employees. The lower transit commuting rate can also be attributed to the abundance of free parking on-campus, which further encourages drive-alone commuting. Employee data show that the majority of workers at the study site live beyond a feasible active commuting distance from work, which is validated in the relatively low (3.0%) of walk and bicycle commuters. Interestingly, a similar trend seems to appear for Midtown commuters (2% active commuters), but not for Downtown commuters (11% active commuters). Overall, the data suggest that the current commuting landscape at the employer work site is heavily dependent on drive-alone commuting when compared to adjacent areas. Given the transit-accessible work site location, as shown by Midtown and Downtown transit commuting rates, a site-specific TDM plan that aims to transfer drive-alone commuters to transit could be effective. Additionally, encouraging the use of carpool through TDM initiatives could act as a solution to reduce drive-alone rates without eliminating vehicle-based commuting altogether.

6.4.2.4.2 Commuting Time, Distance, and Speed

The average one-way commute times, distances, and speeds for various modes are shown in Figure 21, Figure 22, and Figure 23. Across all modes the average one-way commute time was 44 minutes and the average one-way commute distance was 18.0 miles. This correlates to an average commute speed of 24.5 miles per hour (mph). Respondents were asked to input their typical commute times and distances as precisely as possible in an open form response. The results are rather intuitive. Active commuting modes like walking and biking take the relative shortest amount of time, primarily attributed to short average trip distance for those commuters. Transit commuting takes the longest and experiences the longest average commuting trip distance. While MARTA is not known for its expansiveness in metropolitan Atlanta, GRTA Xpress and other regional bus services offer widespread transit service for those commuters living in the outlying suburbs.

Interestingly, carpool and drive-alone commuters have similar commuting speeds, but carpoolers generally travel about 2/3 of the distance and time of drive-alone commuters.

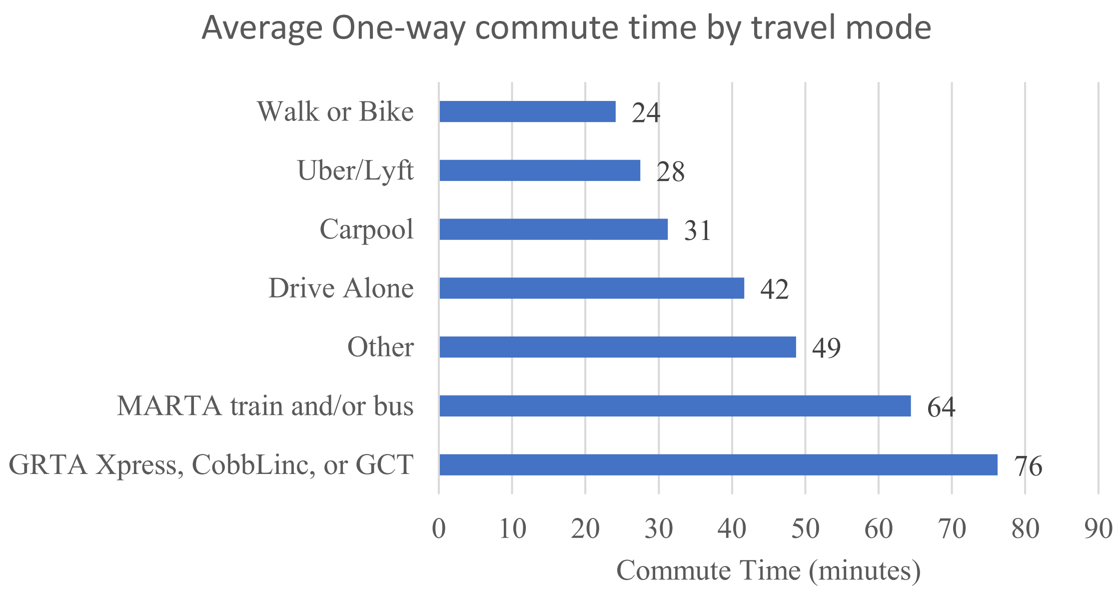


Figure 21: One-way Commute Times Categorized by Primary Commute Mode

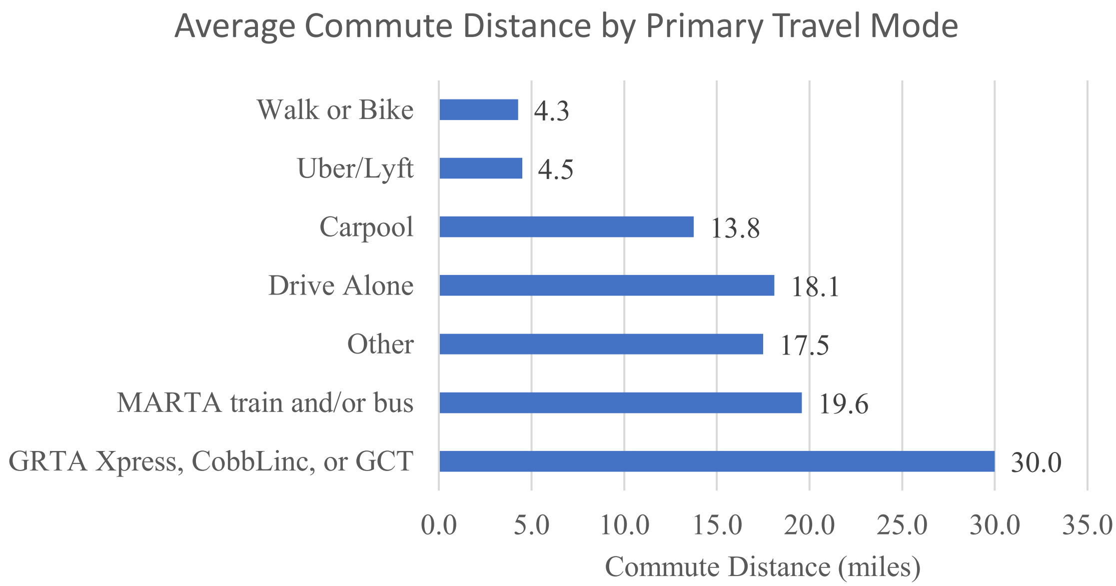


Figure 22: One-way Commute Distances Categorized by Primary Commute Mode

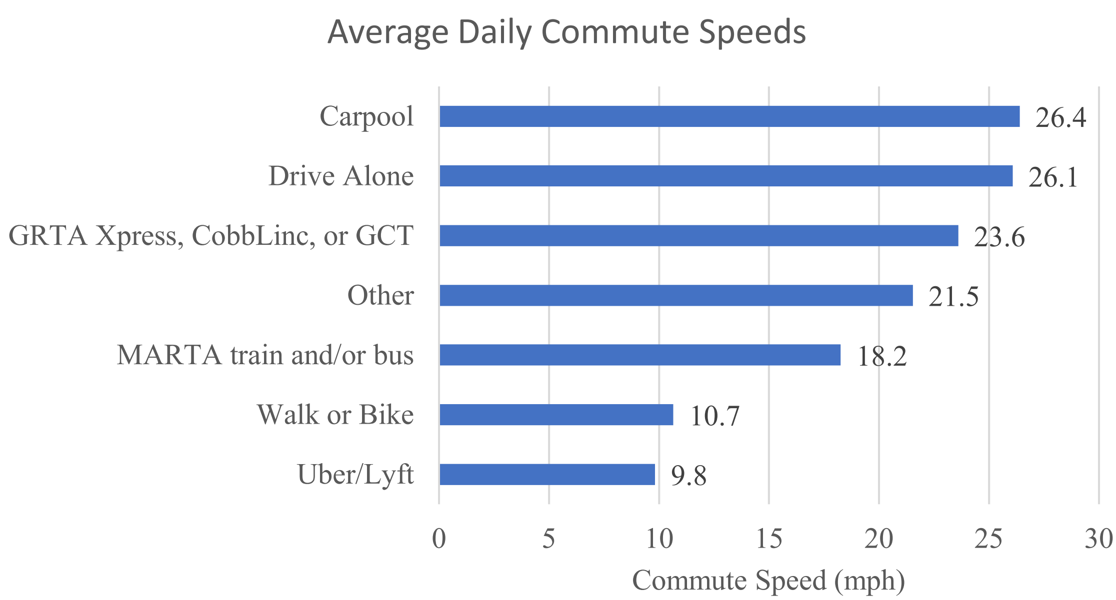


Figure 23: Average Commuting Speeds Categorized by Primary Commute Mode

6.4.2.4.3 Parking Pricing Influence

As discussed previously, the availability of free parking significantly influences travel choices made by commuters. It essentially eliminates the stick, or disincentive, that instigates commuters to consider alternative modes. Free parking is shown to dramatically increase the propensity of drive-alone commuting and charging for parking is shown to be the most effective method to encouraging a mode shift. The major Atlanta employer studied here views parking as an amenity and is averse to charging employees to park at work. To gauge the importance and potential influence of free parking on employee travel behavior, the survey asked respondents to rate the level of influence they feel from the amenity. The results are shown below in Figure 24. The results show that:

- 34% of respondents are heavily influenced by the availability free parking. This group represents the portion of the campus population assumed to be malleable in its travel choices. With the assumption that the survey results are representative of the opinions of the entire associate population on campus, this group would equate to ~1,300 out of the ~3,800 employees that come to campus on a typical day. That is the target population for any type of potential parking cash-out or charging initiative.
- 35% of respondents are not influenced at all by free parking. This indicates that no matter what parking-related incentive or disincentive the company might offer employees, this group, by their own designation, will always take their current

commuting mode. That subset includes people who are fiercely car-dependent or people who currently do not park on campus even though it is complimentary.

- 31% of respondents are partially influenced or agnostic about the influence of free parking on their commute choices. This is the final group of respondents that do not provide conclusive feedback regarding the pricing of parking at the employer work site.

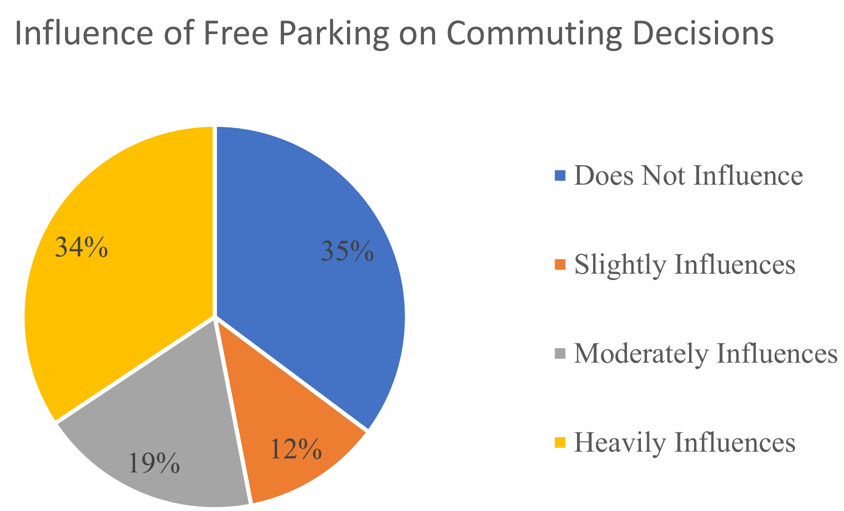


Figure 24: Influence of Free Parking on Commuting Behavior

6.4.2.4.4 Multi-modality

The concept of multi-modality is important in transportation planning, as it represents the portion of the population that is not confined to one single mode of travel. In the car-centric landscape within Atlanta, and most United States cities, the majority of citizens are dependent on their personal vehicle, with no flexibility in travel modes. TDM more effectively influences the other group, those who are open-minded about using a variety of travel modes, or multi-modal. Existing literature indicates that people who are multi-modal are more willing to participate in incentive-based transportation initiatives. Survey respondents were asked to identify both their primary and secondary modes of commuting, with the option to choose “I always use my primary mode”. A multi-modality measure was determined for respondents who indicated that their primary mode was their personal vehicle (primary mode distribution seen in Figure 18). Table 6 shows survey respondents’ self-reported secondary commute modes in descending order of popularity.

Table 6: Survey Respondents’ Secondary Commute Mode

Respondent Secondary Commute Mode	%	Count
I always take my primary mode	49.13%	113
I take Uber or Lyft	14.35%	33
I drive alone	13.04%	30
I take MARTA train and/or bus	6.96%	16
I walk or ride a bicycle	4.78%	11
I work from home and/or come to the office infrequently	4.35%	10
I carpool	3.48%	8
Other (please specify)	2.17%	5
I take GRTA Xpress, Cobb Linc, or Gwinnett County Transit	1.74%	4
Total	**100%**	**230**

The multi-modality measure represents the percentage of respondents who primarily use drive-alone commuting but use another mode of transportation (transit, biking, walking, rideshare, etc.) as a secondary mode. Across all respondents, the survey results indicate a 33.5% average multi-modality rate, which corresponds to about 1,263 associates on campus. That is the portion of the campus population who could be willing to change their travel mode. Figure 25 presents a deeper analysis of the influence of demographic characteristics on multi-modality. The graph delineates groups by age (younger or older than 45 years), gender (male or female), and income level (less than or more than \$120,000/year). The data are represented by the percent difference from the average multi-modality rate of 33.5% (shown as 0% in the graphic). For example, a bar showing -8.0% means that the corresponding demographic group is 8.0% less multi-modal than the average associate on campus.

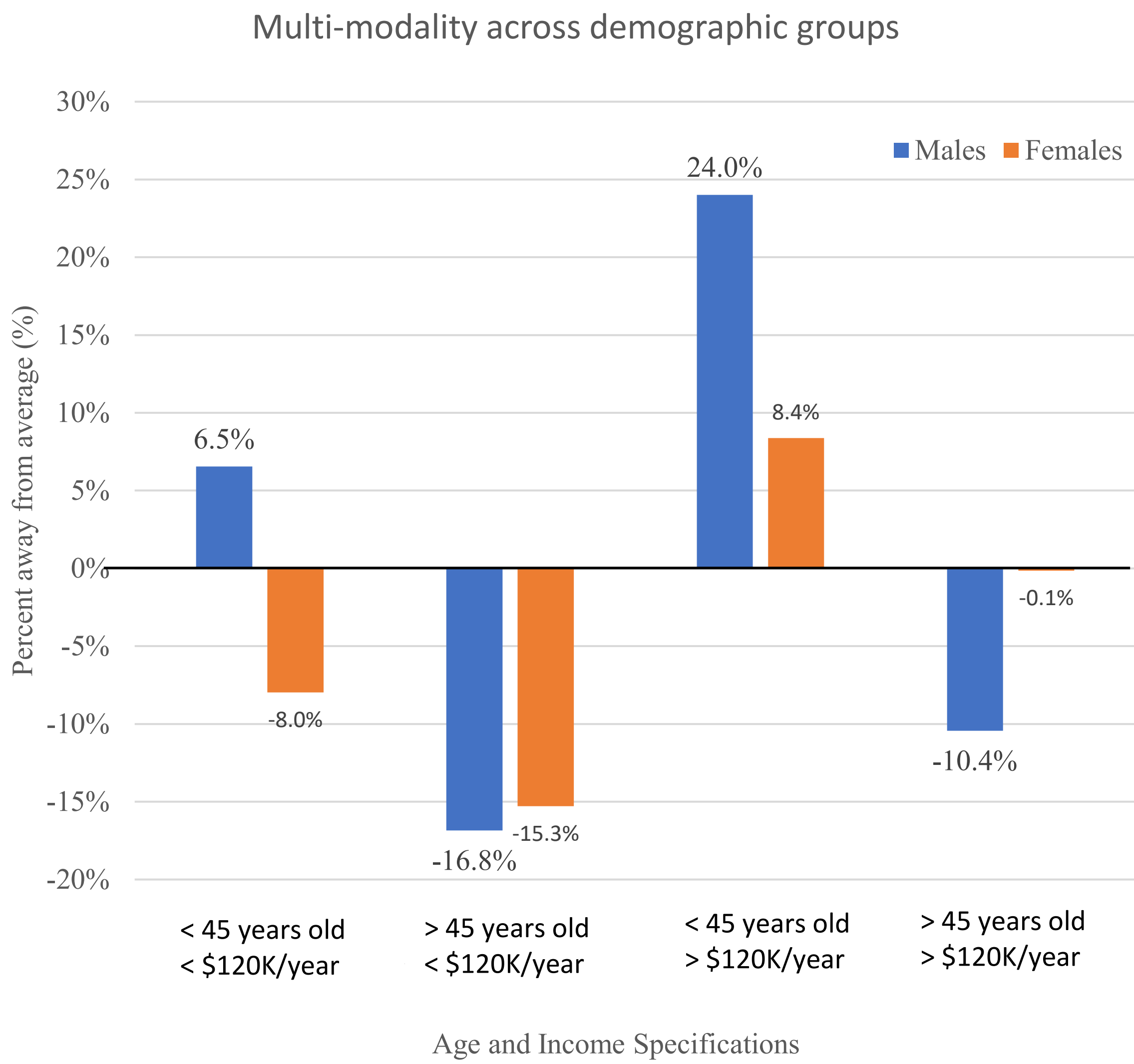


Figure 25: Multi-modality Rates Across Age and Income Groups

This analysis shows the disparity in commuting behavior and flexibility from different demographic groups. The data indicate that women overall stay relatively more consistent in their multi-modality rates than men. The analysis shows that females over the age of 45 and making more than $120,000/year most closely mimic the multi-modal behavior of the average associate, given the -0.1% difference from average. The results show that multi-modality in males is more dependent on their age, as men under the age of 45 are more likely than average (+6.5% and +24.0%) to be multi-modal. They are secondarily influenced by their income, as higher-income men are more multi-modal than lower-income men. Men under the age of 45 with a yearly income over $120,000 represent the most multi-modal group on campus (+24.0%), while men over the age of 45 who make less than $120,000 represent the least multi-modal group (-16.8%). While females generally seem to be less multi-modal than males, a similar trend can be seen, as youth and wealth are shown to translate into increased multi-modality. However, in contrast to males, multi-modality in females is shown to be influenced by income more than by age. In fact, women all under the age of 45, but with yearly incomes under $120,000 and over $120,000, result in 8.0% below average multi-modality and 8.4% above average multi-modality, respectively. This shows the direct impact of income level on multi-modality in women. Less significantly, a younger age translates to increased multi-modality in women, although the overall measure is still below the sample average if they are over 45 years old.

6.4.2.5 Barriers to Entry – Transit

The survey asked respondents to identify their primary reason why they do not commute using transit. Figure 26 displays the number of responses within each provided category. It should be noted that the category “poor flexibility/reliability/convenience” was added retroactively to account for the large number of related responses that were initially designated as “other”. Additionally, various self-reported results that fit into the predetermined categories were recoded to optimize accuracy of the results. As a result of these two actions, the number of “other” responses decreased from 31 to 5 responses. The results were then captured in a more streamlined format, with responses receiving fewer than 8 answers combined into a miscellaneous category. That analysis is shown in Figure 27 and the categories outlined will remain the structure of further transit-related analyses.

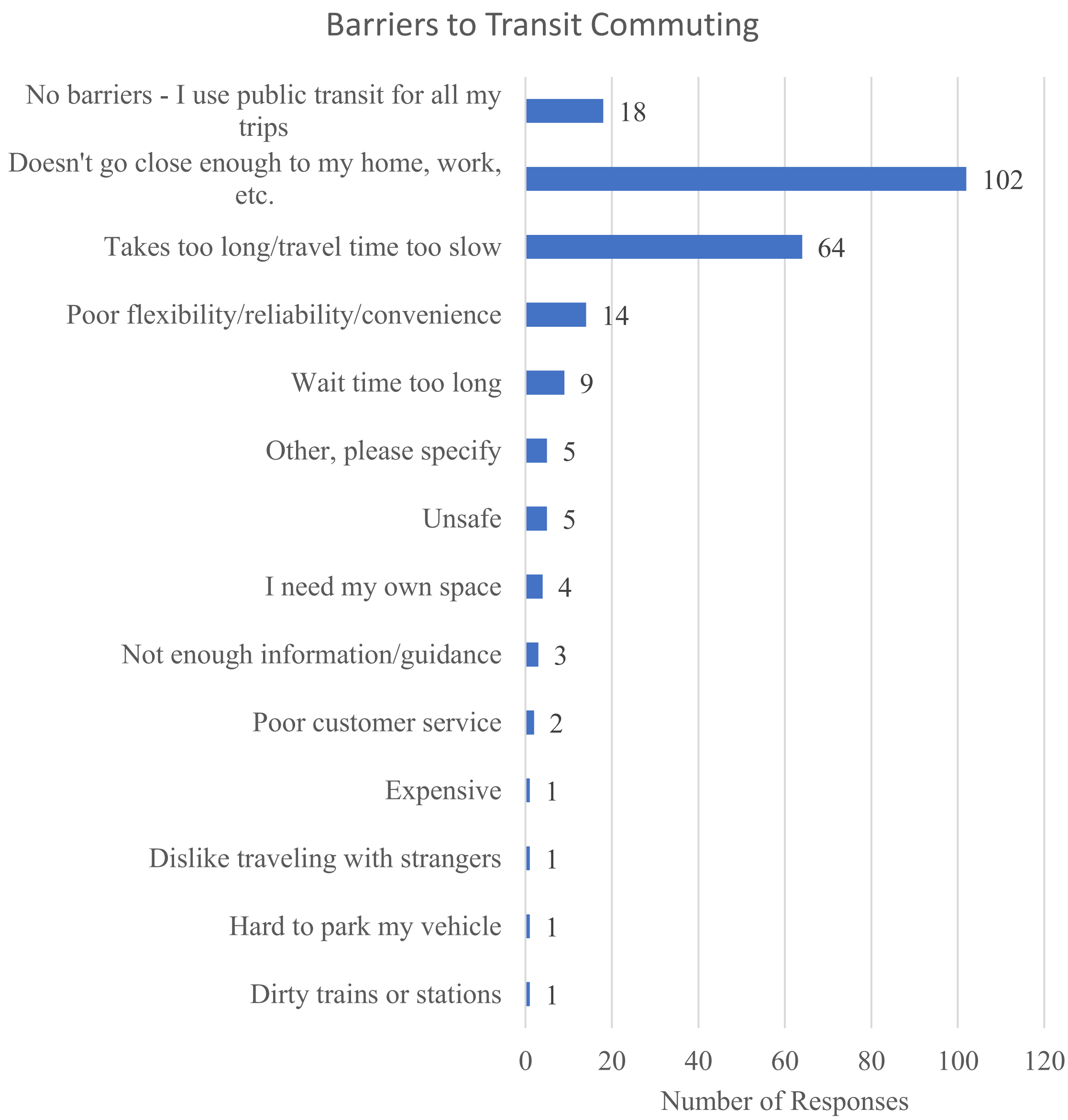


Figure 26: Respondent Barriers to Transit Commuting - Unfiltered

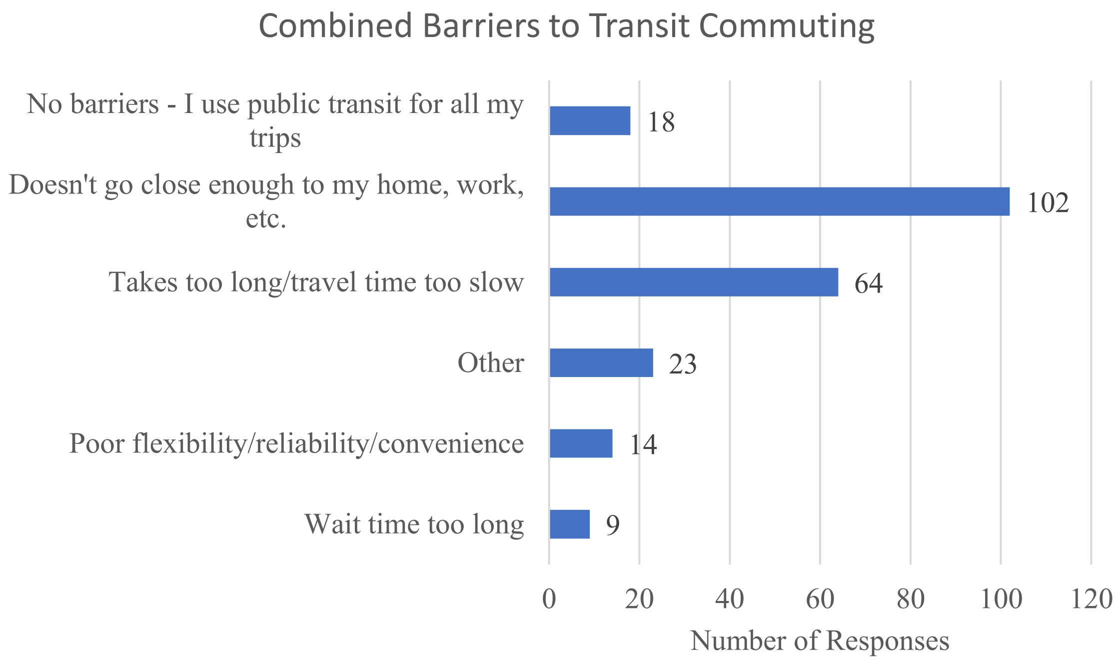


Figure 27: Respondent Barriers to Transit Commuting – Filtered

These data can be interpreted to inform employers about the preferences and related behaviors of their employees. In this case, 44.3% of the employees at the major Atlanta corporation do not use transit because it doesn't go close enough to their origin or destination for it to be a viable option. This is a product of the sprawling landscape and limited geographical coverage of transit within the metropolitan Atlanta region. It should also be noted that perhaps unawareness of nearby transit service inflates this response rate. 27.8% of surveyed associates identified lack of timely transit service as their primary barrier, while an additional 3.9% specified the long wait times. Gleaned primarily from responses initially categorized as “other”, it was determined that 6.1% of respondents avoid transit commuting because it does not offer the flexibility, reliability, and convenience of other commuting options. 10% of responses identified a combination of other factors like safety, personal comfort, parking, or customer service as the primary barriers to transit commuting. The final ~7.8% of respondents stated that they use public transit for all their trips, indicating that there are no prohibitive obstacles. The next set of results will explore the various behaviors and preferences associated with income, gender, and age of the population within the study work site.

6.4.2.5.1 Income-based Barriers

Figure 28 and Figure 29 display the distribution of primary barriers to transit categorized by annual income and the distribution of annual income categorized by barrier to transit, respectively. While there are few clear trends across all income groups, there are some major takeaways. From the lowest income group (<$60,000/year, which represents just 5% of the surveyed population, to the highest income group (<$180,000/year) which represents 24% of the surveyed population, the proportion of respondents who state that their primary barrier to transit is that transit doesn’t go close enough to their points of interest doubles from 30% to 60%. This indicates that either wealthier people tend to live farther away from transit hubs or are more sensitive to distance to transit than those in a lower income class. The lack of identifiable trends indicates that the relationship between income and transit barriers may not be as significant as the relationships of transit barriers with age or gender.

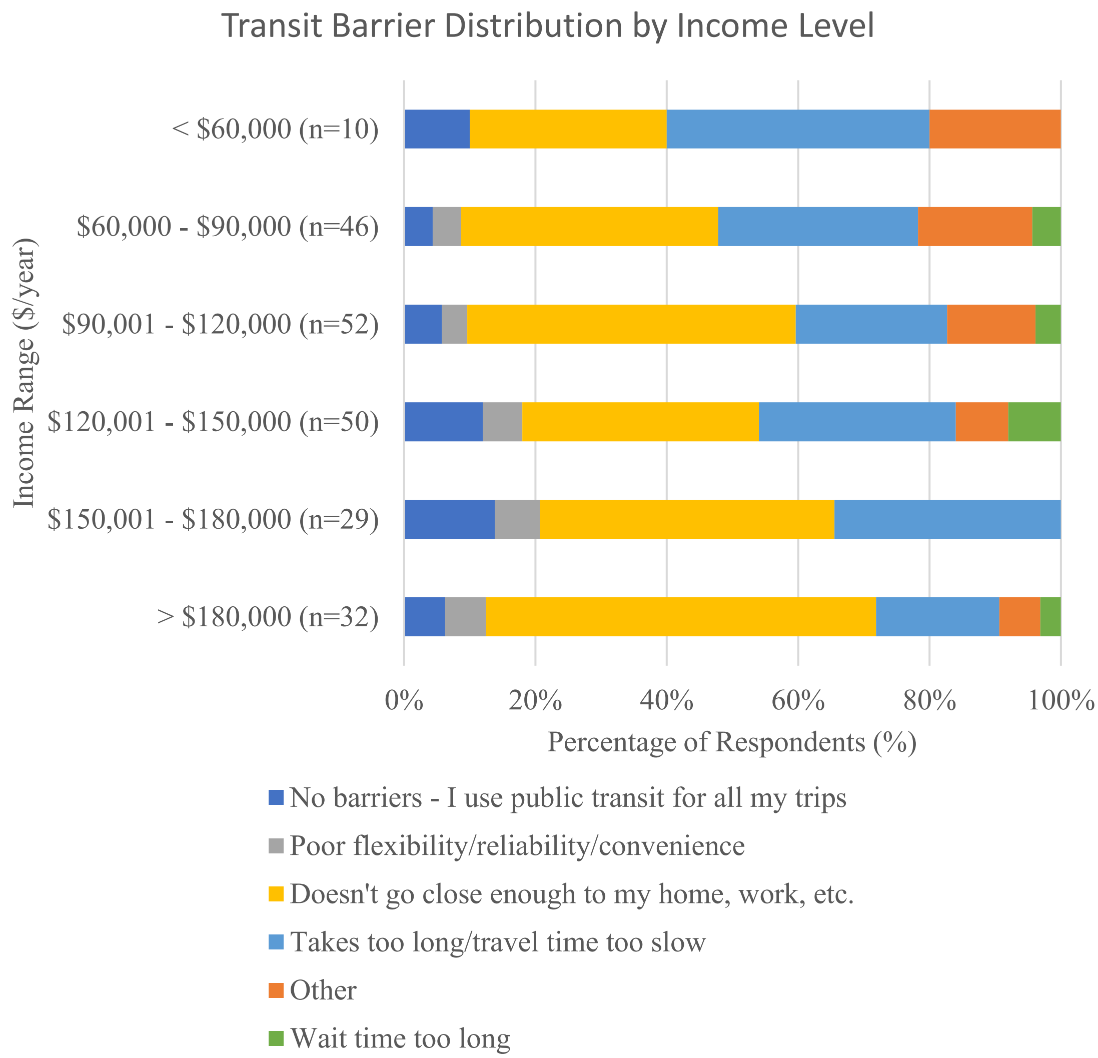


Figure 28: Transit Barrier Distribution by Income Level

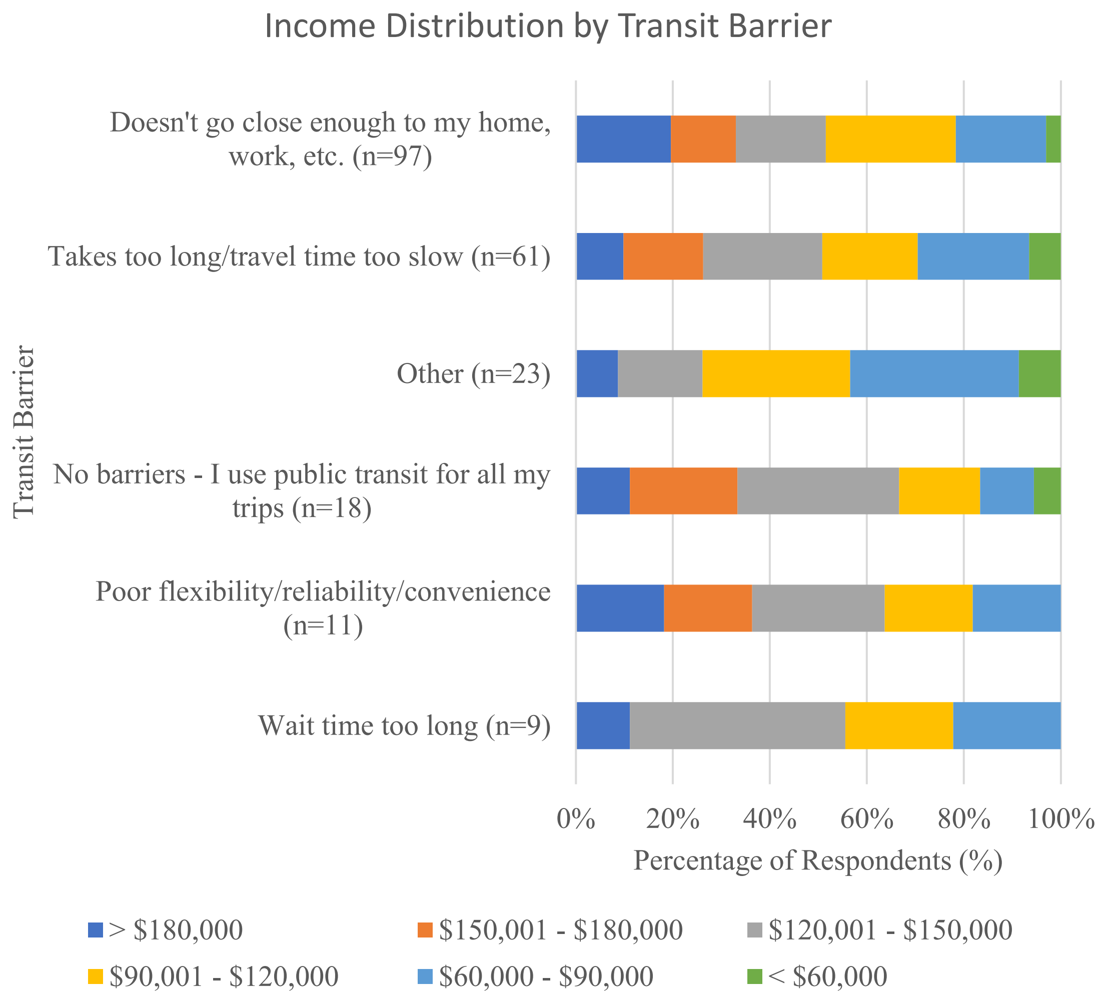


Figure 29: Income Distribution by Transit Barrier

6.4.2.5.2 Gender-based Barriers

Figure 30 and Figure 31 display the distribution of transit barriers categorized by gender and gender categorized by transit barriers. The relationship between gender and transit use can be inferred from these data. The results reveal interesting trends about the attitudinal differences seen between men and women. The output indicates that women tend to be more sensitive to waiting for transit, while men are more sensitive to the travel time. Additionally, women are shown to be more constrained by the lack of flexibility, reliability, and convenience associated with transit. Most responses within this category indicate the need to trip chain for a variety of reasons including children, grocery shopping, or the need to respond to urgent needs. This is intuitive as women have historically been responsible for those tasks within the family unit. Males overall seem to have a higher propensity to take transit than their female counterparts.

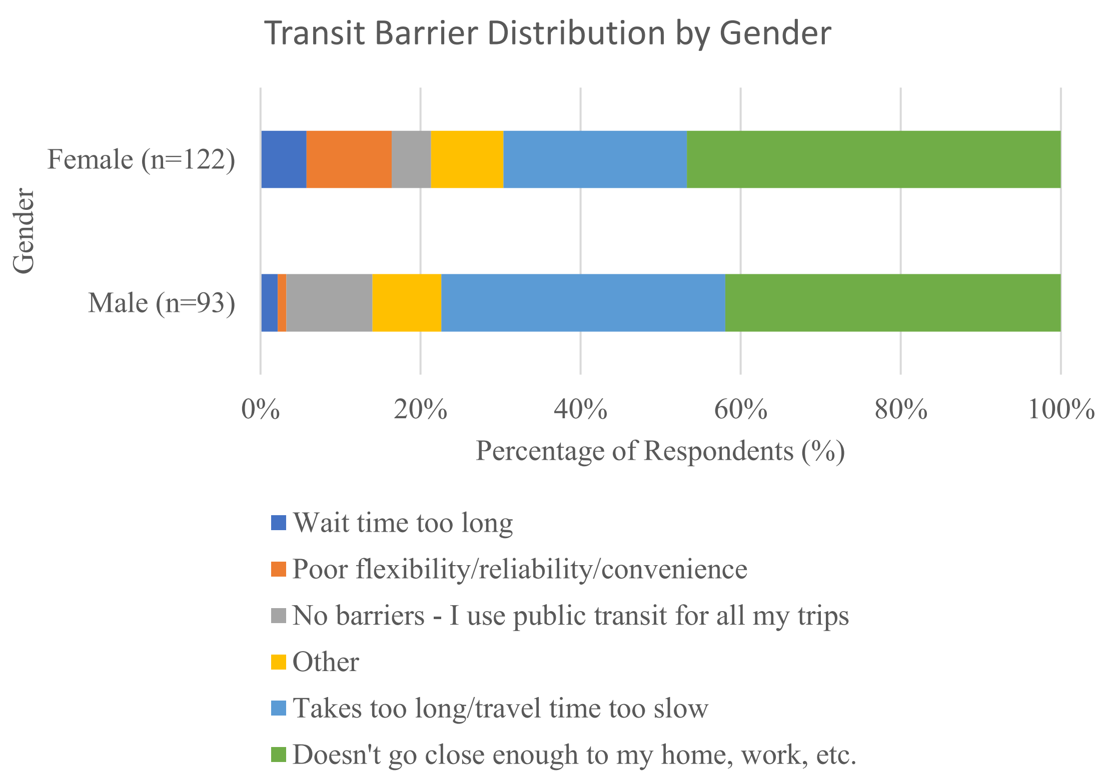


Figure 30: Transit Barrier Distribution by Gender

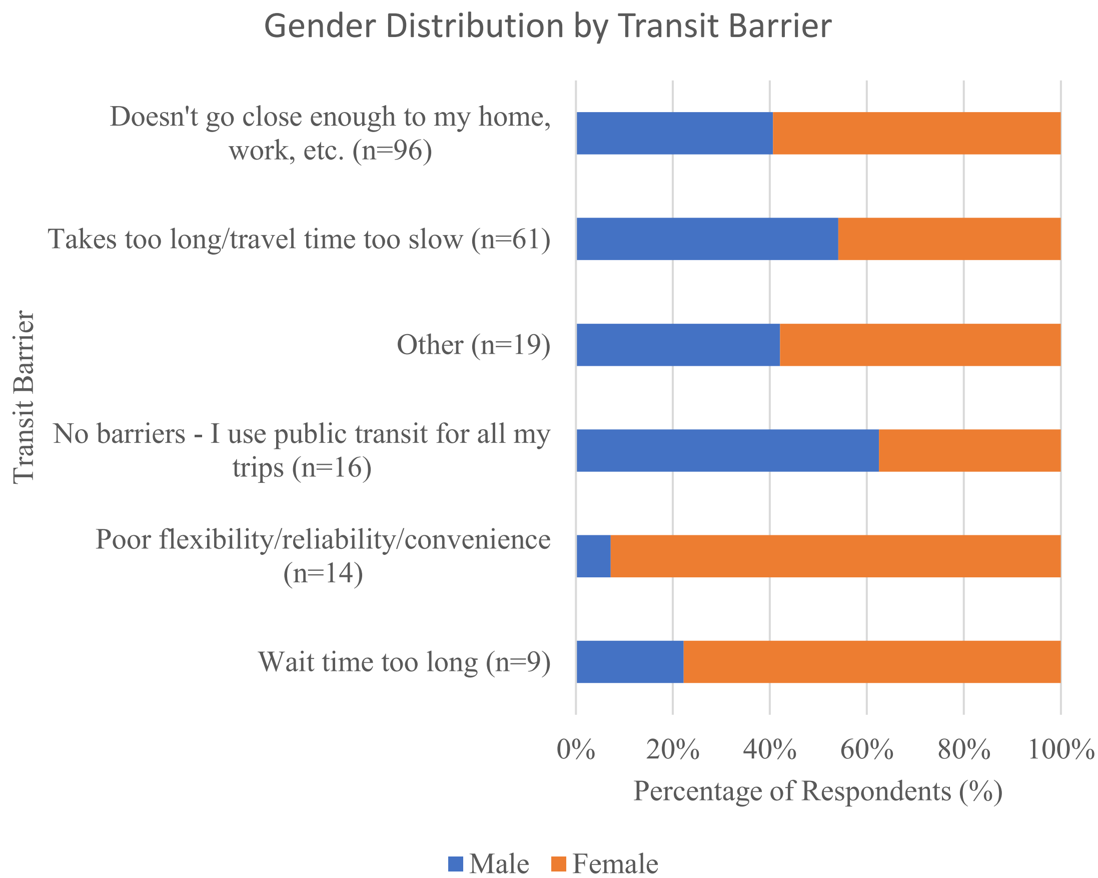


Figure 31: Gender Distribution by Transit Barrier

6.4.2.5.3 Age-based Barriers

Figure 32 and Figure 33 display the relationship between age and transit barriers to entry. The data suggest that between the ages of 25 and 55, employees experience similar levels of sensitivity when it comes to their proximity to transit. Also, the results reveal a positive relationship between age and transit usage, with the percentage of age group respondents who use transit for all their trips increasing as their age category increases.

Both graphs show that a sensitivity to the flexibility, reliability, and convenience of transit peaks in the 35 – 45-year-old age group. This aligns with the theory of trip chaining for child-related responsibilities, as 35 – 45-year-olds generally show the highest likelihood of having children at a school-attending age (ages 5 – 16). It should be noted that employees under the age of 25 represent just 2% of the surveyed population, so conclusive inferences should not be made based on these outputs.

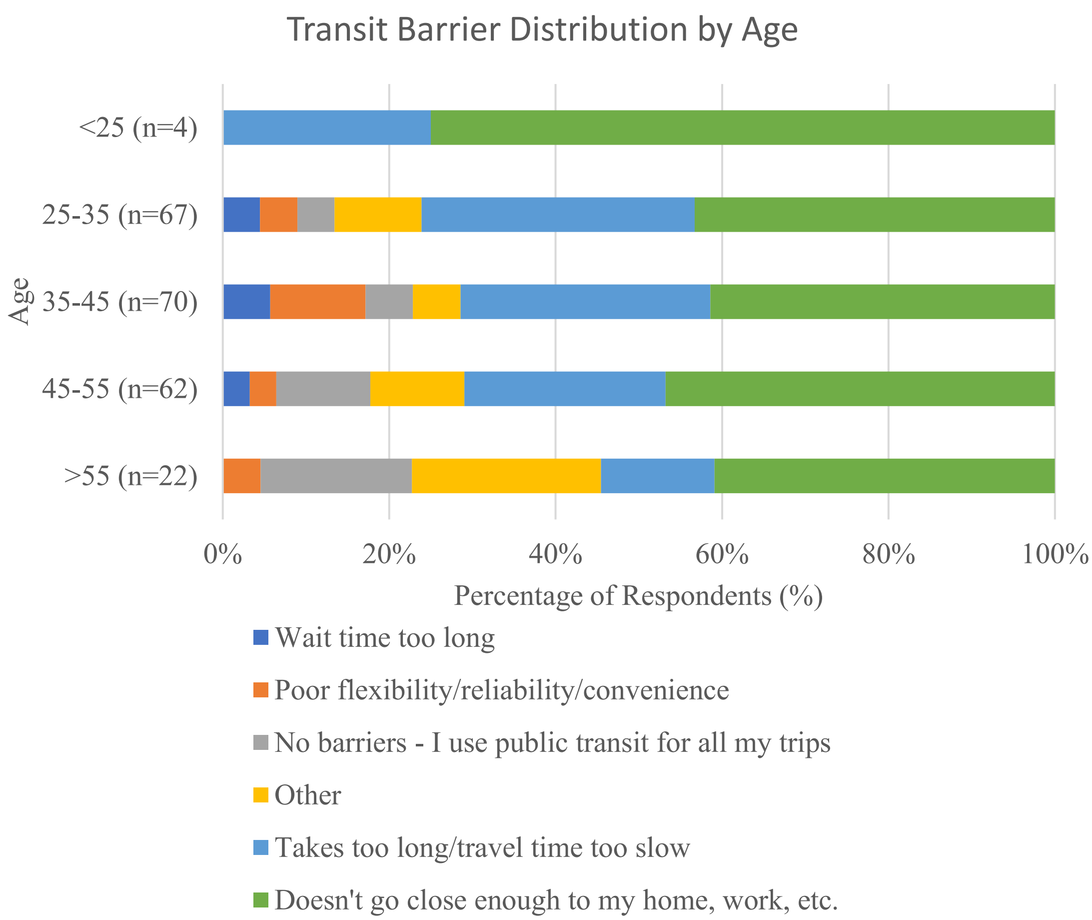


Figure 32: Transit Barrier Distribution by Age

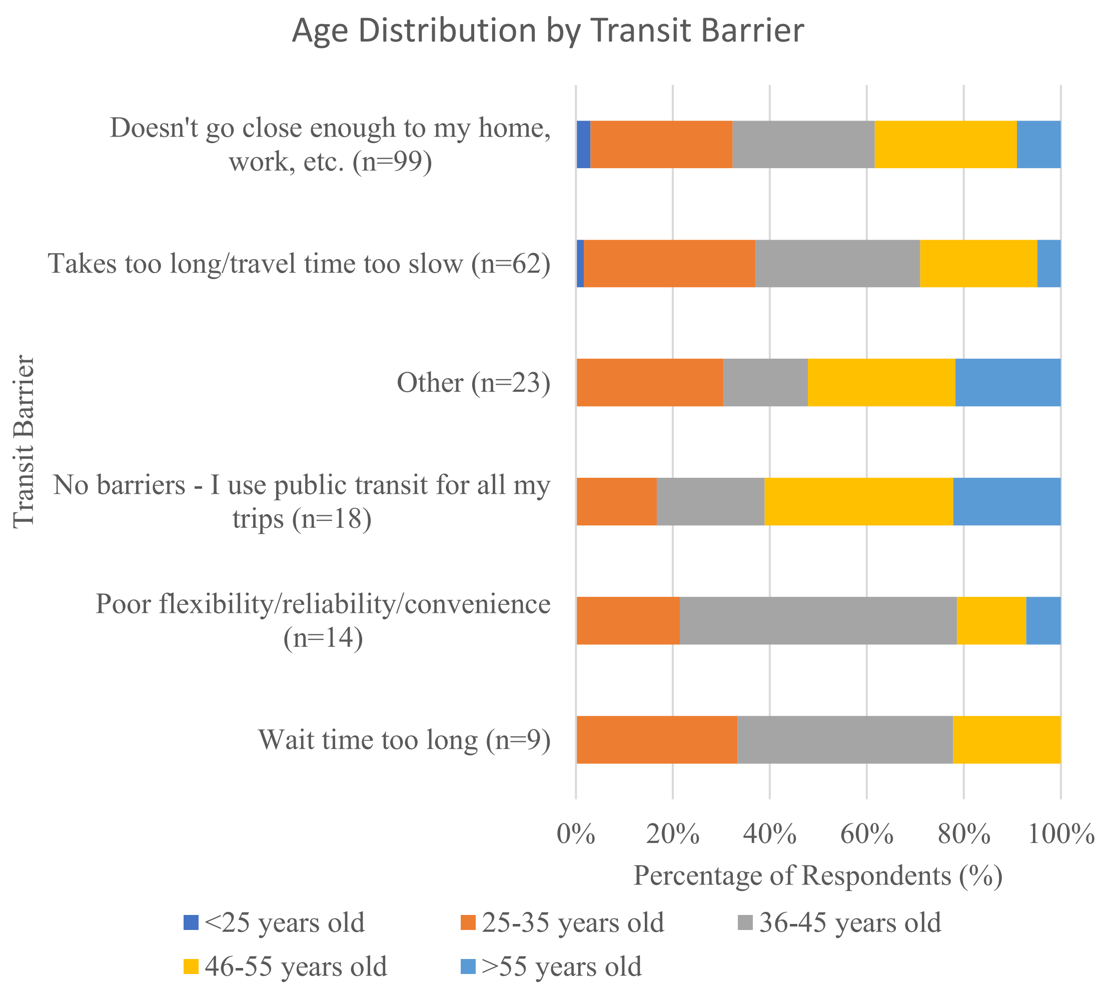


Figure 33: Age Distribution by Transit Barrier

6.4.2.5.4 Overall Findings

In general, the major takeaways from this research indicate that the overwhelming majority of respondents (72%) feel that public transit does not provide adequate access to their commuting origins or destinations, or that the service takes too long to transport them between origin and destination. The challenges in access or timeliness of transit service outweigh the benefits of public transportation for most people, illustrated in the mere 7.8% of respondents who identified the current Atlanta transit network as having no prohibitive challenges. Across income, gender, and age analyses, the results indicate various conclusive trends. Higher income groups show an increased sensitivity to lack of transit access than lower income groups, meaning commuters with higher incomes are not willing to travel as far on either end of their transit trip. Intuitively, higher income individuals have a higher value on their time when compared to lower income employees, so the increased time-cost of travel on the first and last legs of a transit trip are more likely to preclude those individuals from using public transit in general. Males are shown to be more likely to take public transit than their female counterparts, while females are shown to be more heavily influenced by the lack of flexibility offered by public transit trips. Furthermore, age-based results indicate that the lack of flexibility, reliability, and convenience of transit peaks as the most influential barrier within the 36 – 45-year-old age group. Both of these data points align with the concept that middle-aged women are most likely to have trip chaining responsibilities.

6.4.2.6 Barriers to Entry – Carpool

Survey respondents were also asked to identify their primary reason for avoiding carpool commuting, that is commuting with another employee, either as a driver or passenger. Similar to the transit analysis, if a response did not fit into the predetermined categories, respondents chose “other” and specified their reason. These responses were recoded if they fit within one of the main categories. Figure 34 displays the raw output from this question, and Figure 35 shows the filtered carpool barrier results. Figure 36 displays the data in percentage-based format.

In contrast to the transit barrier results obtained, which were primarily influenced by the spatial and operational limitations of the transit network, a significant portion of respondents identified carpool-specific barriers that are more easily addressed from an employer perspective. Working under the assumption that personal responsibilities or preferences, and the resulting travel behavior, cannot be changed without compensation, the carpool barrier responses related to the necessity of trip chaining or preference of personal travel sovereignty are not likely to be adaptable. However, barriers associated with lack of available partners or perception of complication can be remedied through carpool-based initiatives. This portion of respondents, including those who already commute via carpool (24.4%), can be classified as carpool-eligible (shown in green). Improved employer emphasis on flexible work schedules could be an additional effort toward overcoming another primary carpool barrier. Including those respondents identifying work schedule concerns as their primary barrier (shown in yellow), the carpool-eligible population increases to 45.7%.

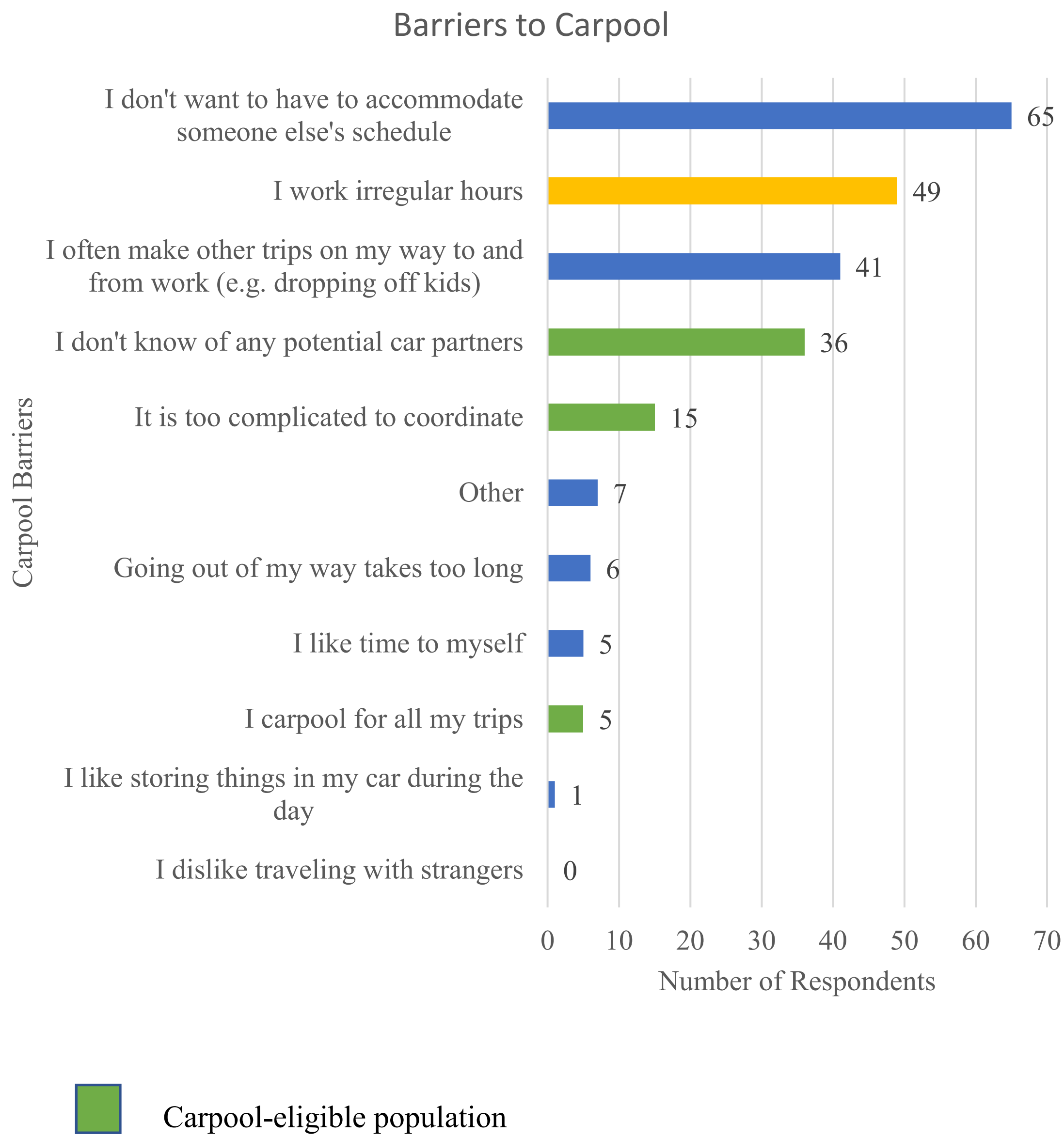
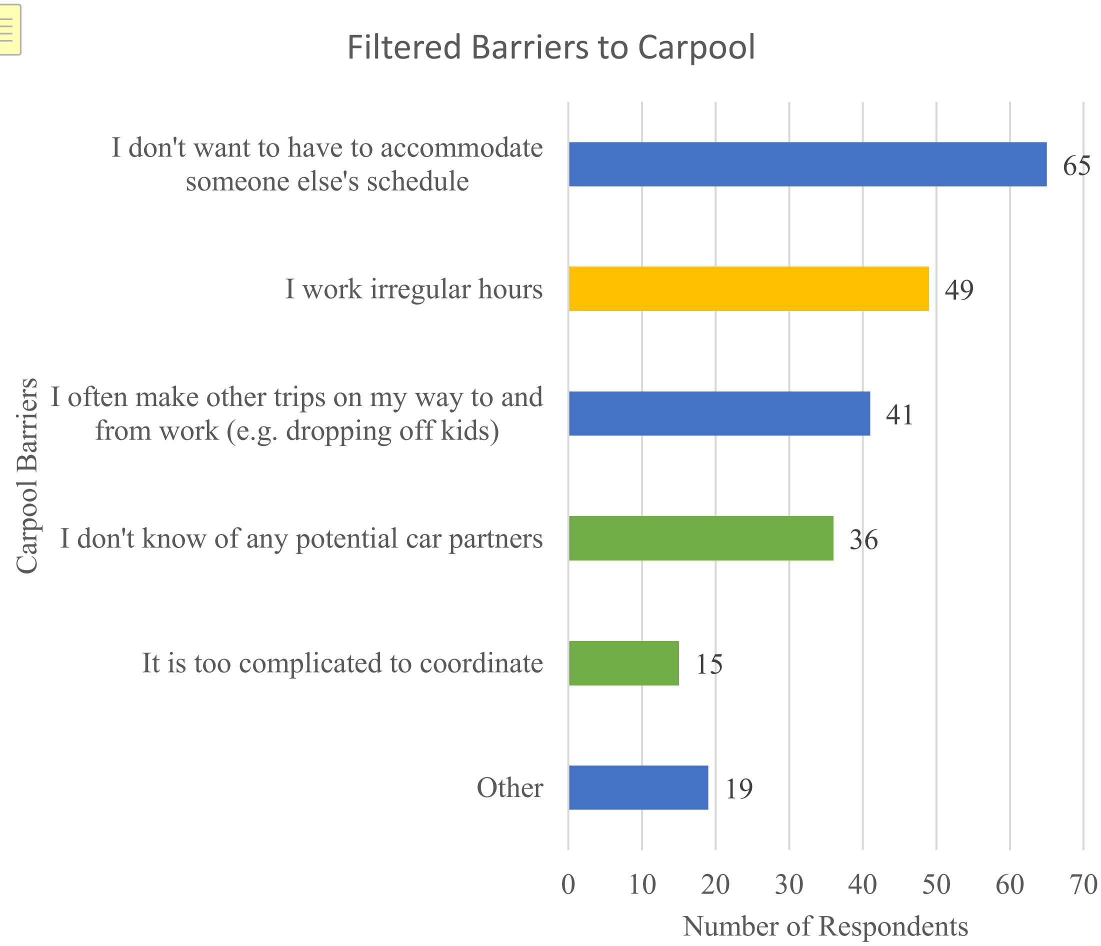


Figure 34: Respondent Barriers to Carpool – Unfiltered



Carpool-eligible population

Figure 35: Respondent Barriers to Carpool - Filtered

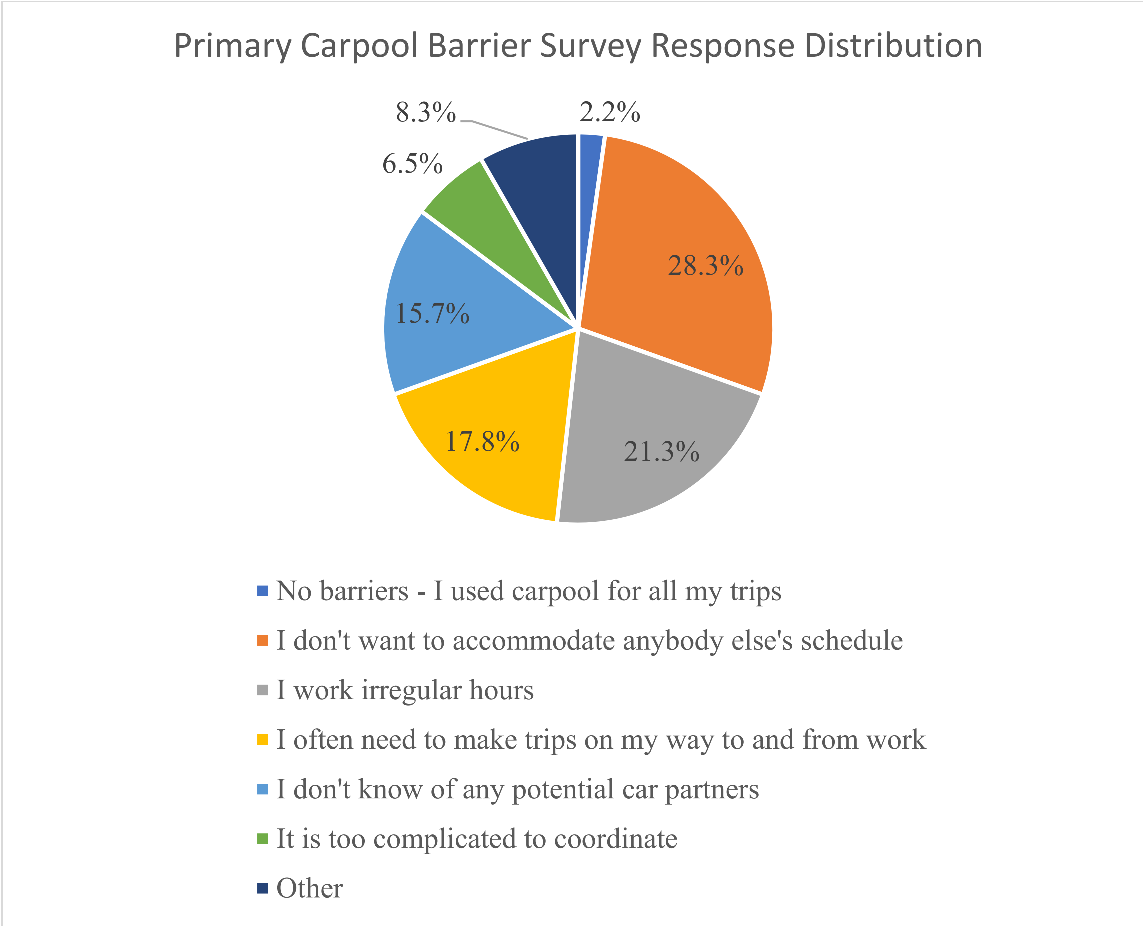


Figure 36: Distribution of Respondent Primary Carpool Barriers

6.4.2.6.1 Income-based Barriers

Figure 37 and Figure 38 illustrate the relationship between income and respondents' primary barriers to carpool. While the results are interpretable, there remains no clear or defined correlation between the two variables that manifests consistently across all income groups. It can be speculated that income has minimal influence over travel behavior and is more of a supplementary determinant to age. The graphs below show that the primary carpool barrier distribution remains relatively consistent across all income levels, and that the distribution of income levels remains consistent across identified carpool barriers. While respondents earning less than $60,000 per year only make up 5% of the sample population, that result shows that the group is more likely to be affected by trip chaining than any other income group. Respondents in the highest income class, those earning over $180,000 per year, are the least affected by the need to trip chain. While this trend is not validated across all income groups, it can be posited that wealthier employees have other options to handle tasks that involve trip chaining. They may have a partner or nanny that picks up children from school, or a hired grocery shopper. A similar interpretation can be made about work schedules. The data show that the less than $60,000 per year income group did not have a single respondent indicate that irregular work hours prohibited them from carpooling. In contrast, about 1/3 of respondents in the more than $180,000 per year income group chose irregular work hours as their primary barrier to carpool. This relationship is intuitive, as lower income individuals tend to work more traditional 8 AM to 5 PM jobs. This trend is not validated across the middle income-groups, where the level of influence of irregular work hours remained relatively constant. The $120,000 - $150,000 per year group are shown to be the most carpool-eligible cluster, representing about 874 (23%) on-campus associates.

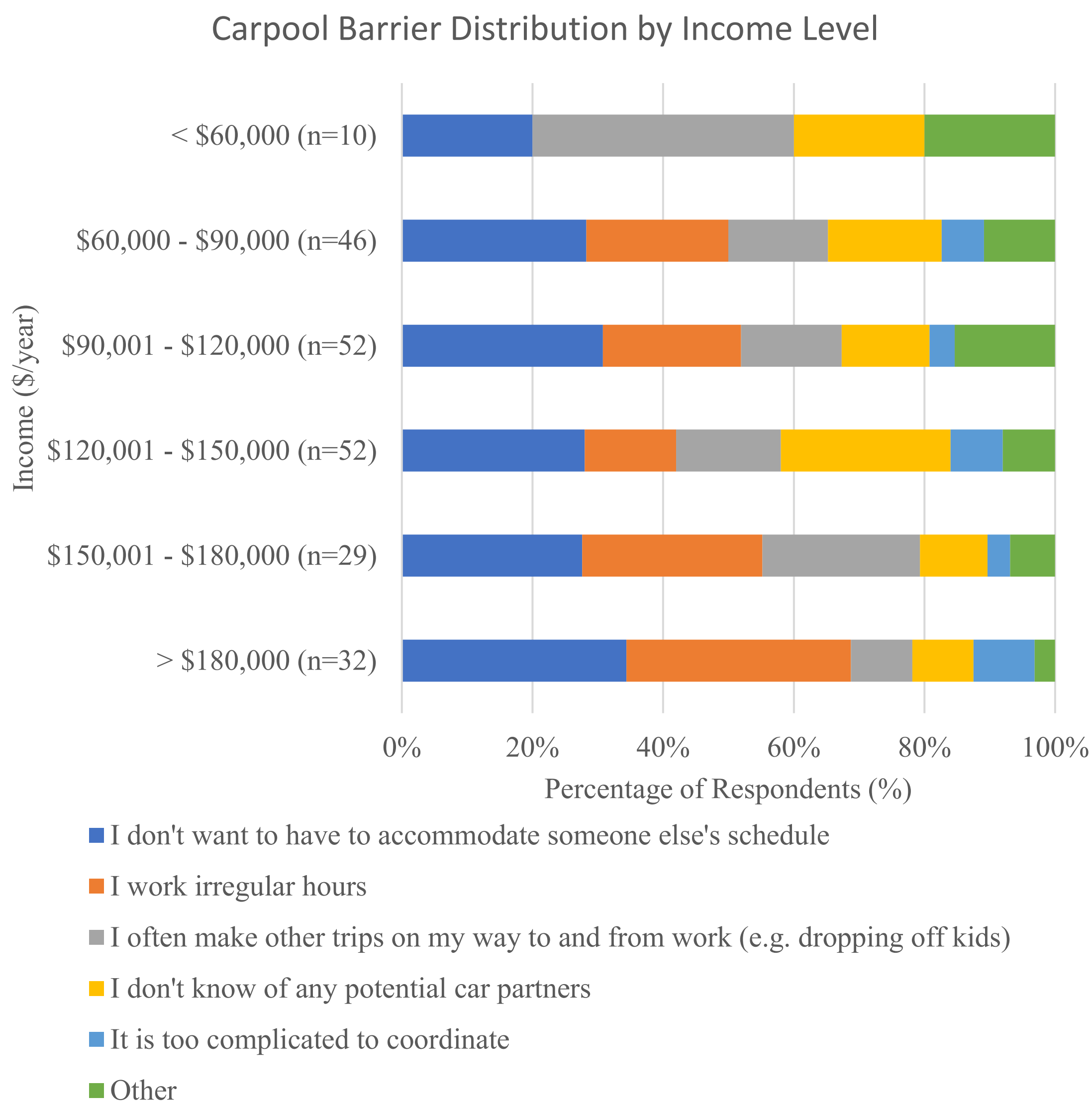


Figure 37: Carpool Barrier Distribution by Income Level

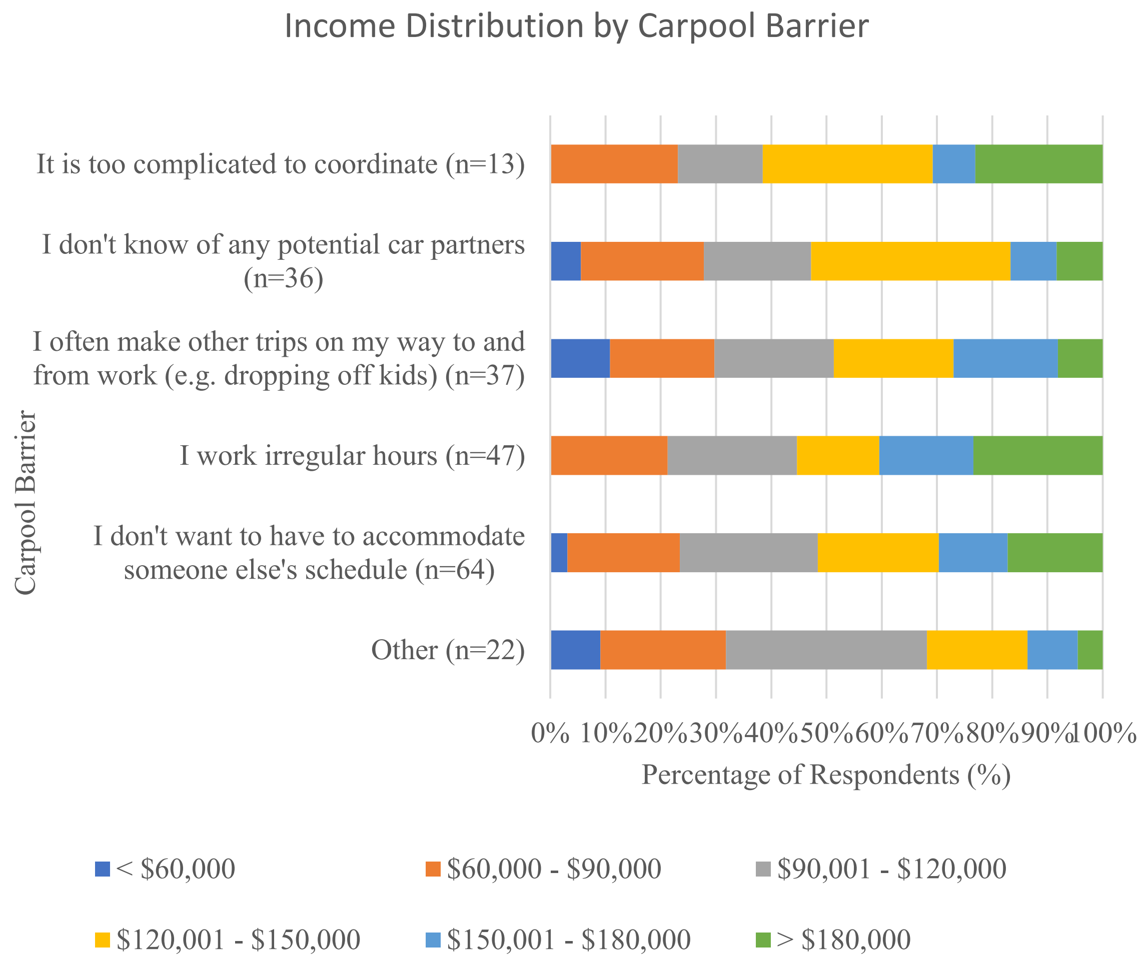


Figure 38: Income Distribution by Carpool Barrier

6.4.2.6.2 Gender-based Barriers

Figure 39 and Figure 40 display the relationship between gender and carpool barriers. Note that females made up 57% of the survey respondents. There are a few major takeaways from the graphs below. Trip chaining reveals itself as a precluding factor that is more prevalent in women than in men, which aligns with the transit analysis discussed previously. Women indicated the need to make other mid-commute trips as their primary barrier to carpool about 2.5 times more than men (25% to 10%). Men show more likeliness for working irregular hours as well as relatively less patience for the coordination of carpool logistics. Overall, the results indicate that women are the more “carpool-eligible” gender.

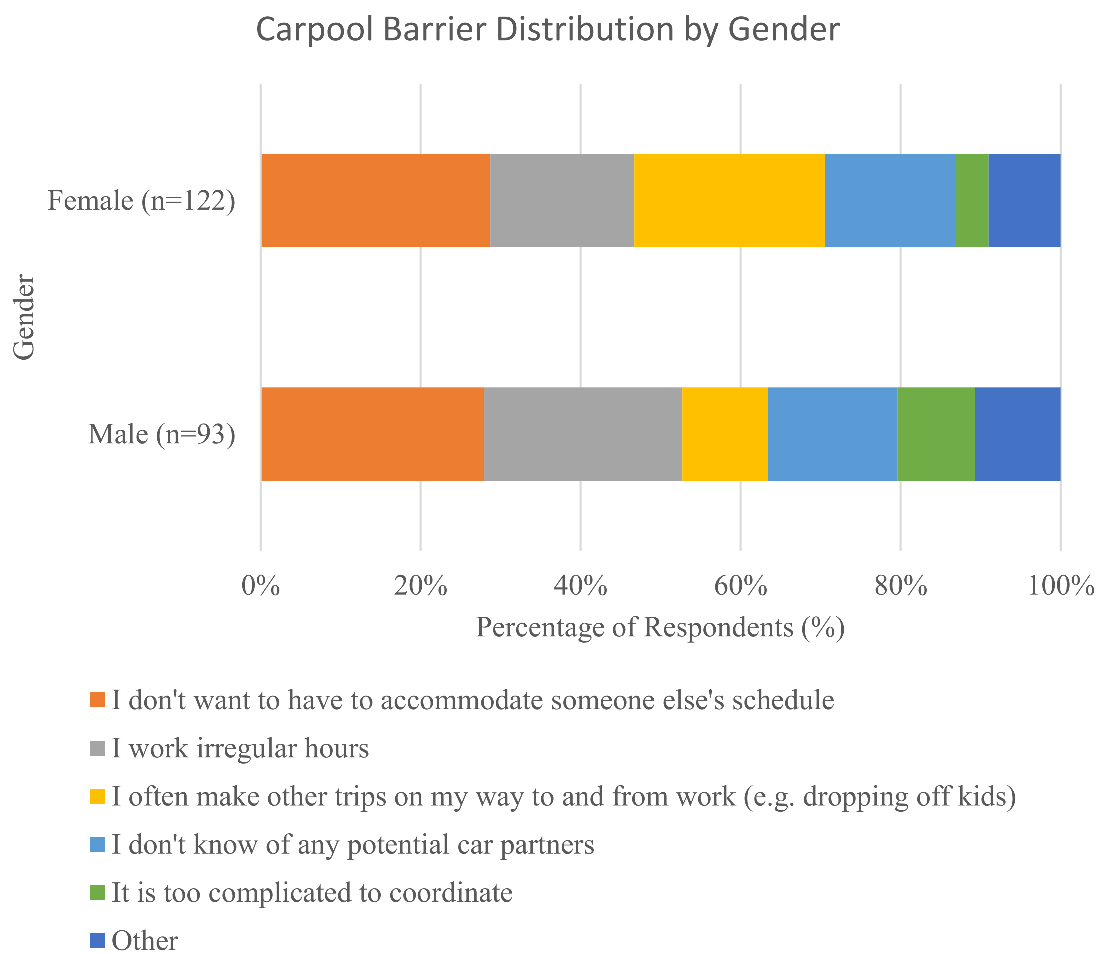


Figure 39: Carpool Barrier Distribution by Gender

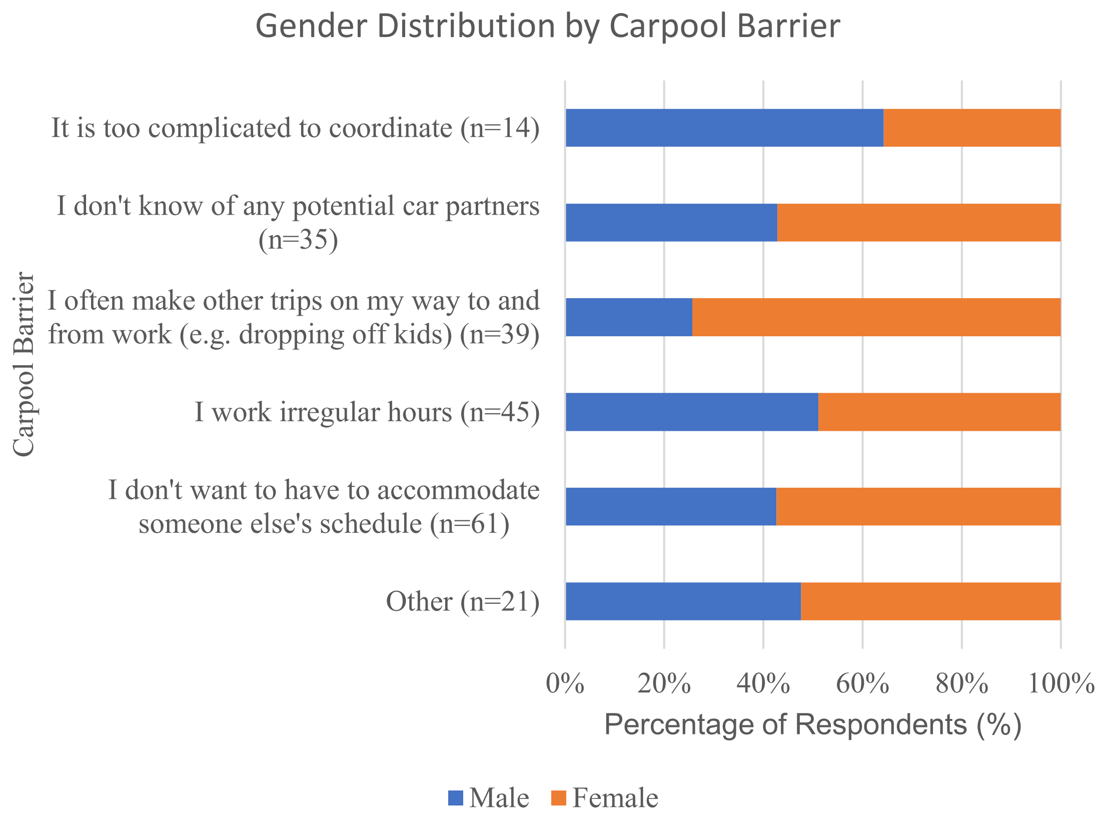


Figure 40: Gender Distribution by Carpool Barrier

6.4.2.6.3 Age-based Barriers

Figure 41 and Figure 42 below display the relationship between age and carpool barriers to entry. While age is predicted to be significantly correlated with income level, these charts show more interpretable relationships. It should be noted, again, that respondents under the age of 25 only accounted for 2% of the sample, so conclusive results are not given. The data show that, in general, younger employees have less patience when it comes to the logistical coordination of carpooling. While the complexity of coordination makes up a relatively small percentage of the identified primary carpool barriers, a trend can be seen across all ages (excluding those under 25 years old). As age decreases, the necessary carpool coordination becomes an increasingly prohibiting factor. Identification of the barrier is not present in responses from those over the age of 55, and almost doubles in percentage as the primary barrier between the 45-55-year age group and the 25-35-year age group. This indicates that the younger generations have an increased need for quick response, which can be linked to recent advances in technology and the ubiquitous availability of information at one's fingertips.

The results also indicate that an increase in an employee's age influences the level of irregularity in their work schedule. The graphs show that older employees tend to be increasing unamenable to carpool due to their work schedules. Specifically, those employees over the age of 35 experienced a significant increase in irregular work schedule as their primary barrier to carpool, and the percentage remained relatively consistent through the older population. These data could be correlated to the age in which most people start families or start to have more autonomy in their work responsibilities.

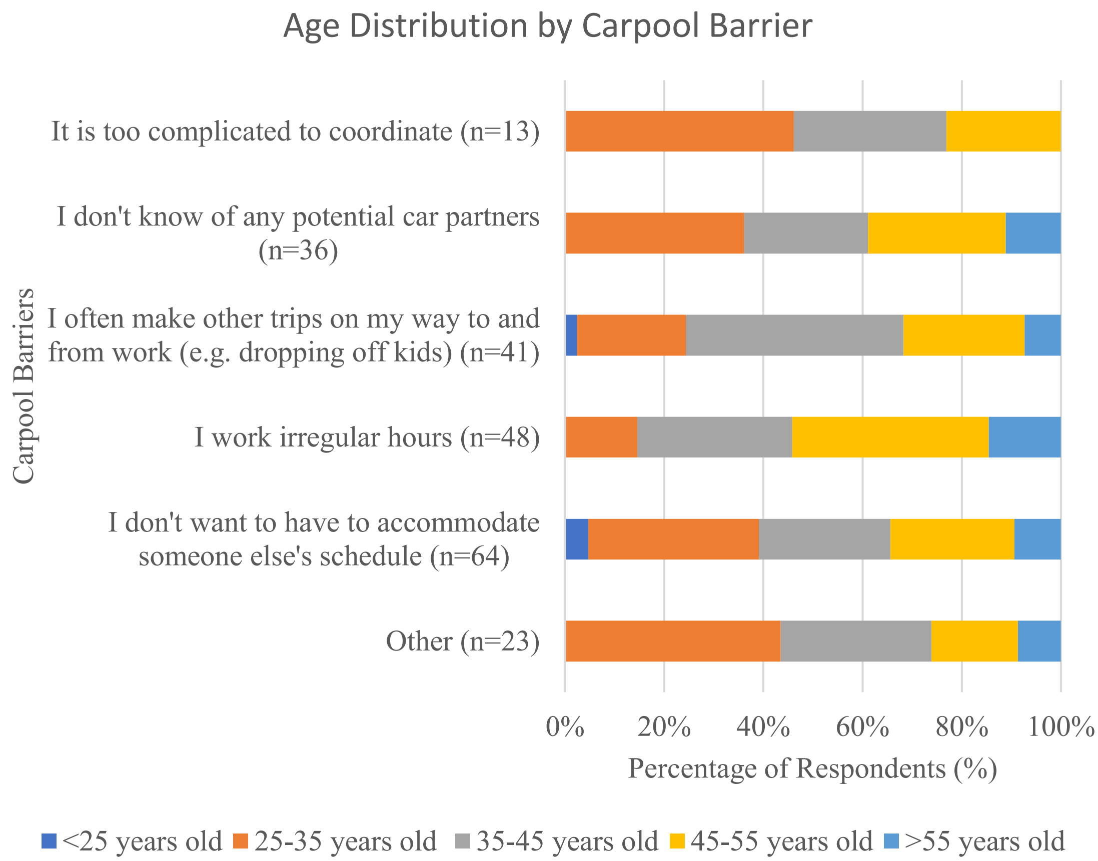


Figure 41: Age Distribution by Carpool Barrier

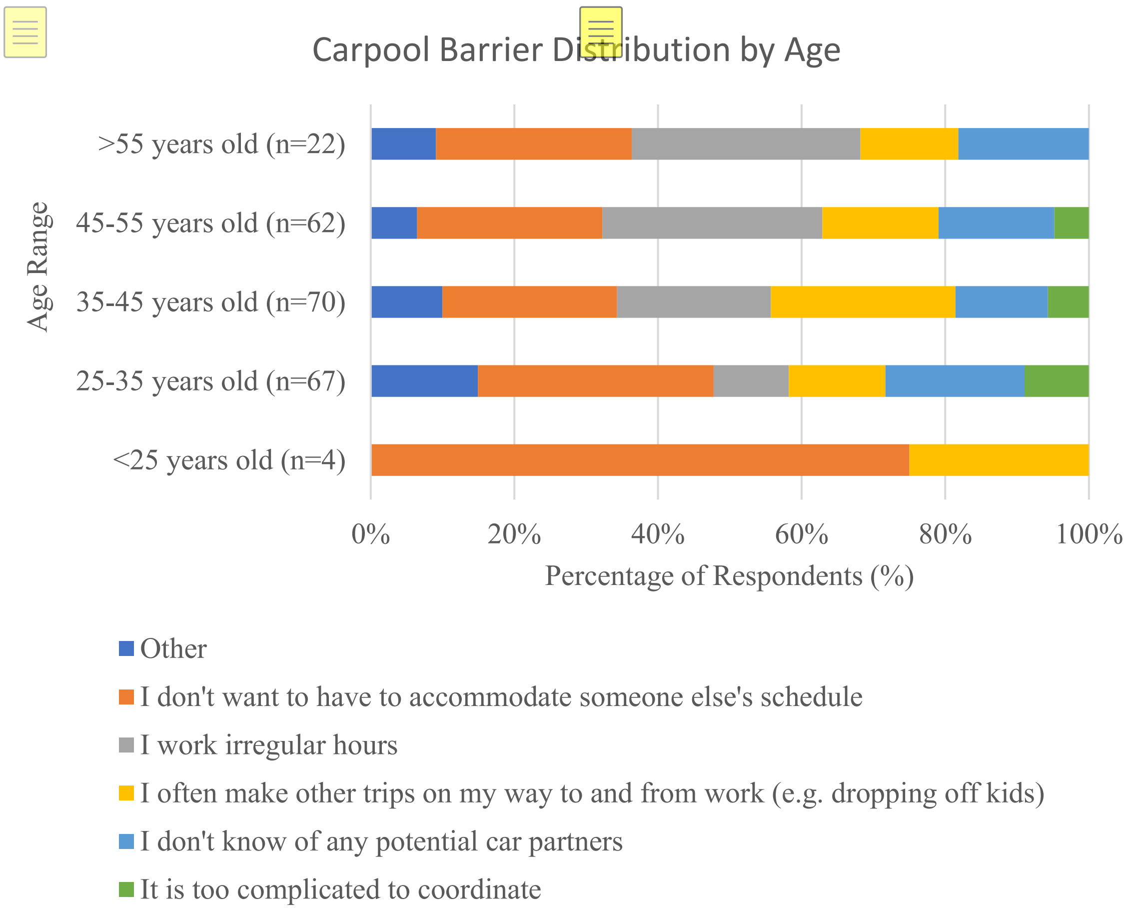


Figure 42: Carpool Barrier Distribution by Age

6.4.2.6.4 Overall Findings

The carpool analysis above presents a more evenly distributed array of carpool barriers when compared to the preceding transit analysis. While the highest percentage of respondents (28.3%) expressed an aversion to accommodating another person's schedule, factors like irregular work schedule (21.3%), necessity of trip chaining (17.8%), and lack of knowledge of carpool partners (15.7%) are all shown to be heavily influential in travel decisions. The convertible "carpool-eligible" population, those individuals who indicated that they primarily do not engage in carpool for reasons related to lack of partners or coordinative ability, comprises about 23% of the study work site. Additionally, employer-led enhancement of flexible work hours could expand carpool eligibility to 45% of the population. Income was shown to be a trivial factor in carpool travel decisions, with a greater influence tied to gender and age. Women are shown to be the more carpool-eligible gender, despite being barred by trip chaining responsibilities at 2.5 times the rate of their male counterparts. The data show that younger employees have a need for immediacy, whereas older employees seem to have more patience for carpool coordination, correlating to a negative relationship between age and the ability to endure the logistical challenges generally considered to be present in conventional carpooling methods. The age of 35 represents an inflection point in the influence of irregular work schedules on propensity to carpool, with employees who are younger than 35 being significantly less affected than employees who are older.

6.5 Statistical Analysis

A stated preference (SP) experiment was presented to respondents in the final part of the survey. This section allowed commuters to compare various combinations of factors deemed potentially influential in travel behavior decisions and choose their preferred alternative. Four packages were created to encompass primary commuting modes: "Personal Vehicle Driver", "Carpool Driver", "Carpool Passenger", and "Transit Rider". Different levels were applied to eight attributes spread across the packages, facilitating a multinomial logit discrete choice model (DCM) analysis. The "Personal Vehicle Driver" package acts as the reference alternative, using the status quo for the attribute levels. Financial incentive remained $0, additional travel time remained 0 minutes, and matching characteristics did not apply. The package options created scenarios where respondents could weigh the relative benefit perceived from a combination of an employer-provided financial incentive, additional travel time, and carpool matching methods against the default characteristics of a personal-vehicle commute. Respondent choices, and the subsequent analysis with personal characteristics, determine the effect of each variable on an individual's commute behavior, informing employer transportation coordinators of the most effective combinations of attributes needed to convert target audiences to alternative commute modes. The SP packages and attribute levels are outlined below in Table 7:

Table 7: Stated Preference Survey Summary

Packages	Attribute Name	Levels			
		1	2	3	4
Carpool Driver Package	Carpool Driver Incentive ($)	$2/day	$4/day	$6/day	$8/day
	Carpool Driver Added Travel Time (min)	5 min	10 min	15 min	20 min
	Carpool Driver Matching Characteristics	Job Type	Demographics	Interests	Random
Carpool Passenger Package	Carpool Passenger Incentive ($)	$2/day	$4/day	$6/day	$8/day
	Carpool Passenger Added Travel Time (min)	0 min	5 min	10 min	15 min
	Carpool Passenger Matching Characteristics	Job Type	Demographics	Interests	Random
Transit Package	Transit Incentive ($)	$2/day	$4/day	$6/day	$8/day
	Transit Added Travel Time (min)	15 min	20 min	25 min	30 min

With three different packages (not including the drive-alone reference package), eight total parameters, and four levels each, SAS statistical software was used to generate 32 trade-off questions. To compensate for the predicted complexity and fatigue that all 32 SP questions would invoke in respondents, the survey was broken down into four sets of eight questions, randomized across respondents. This method allows conclusive inferences to be drawn from the results, without compromising respondent participation rates. An example question is shown in Figure 43, and all survey questions are displayed in APPENDIX A.

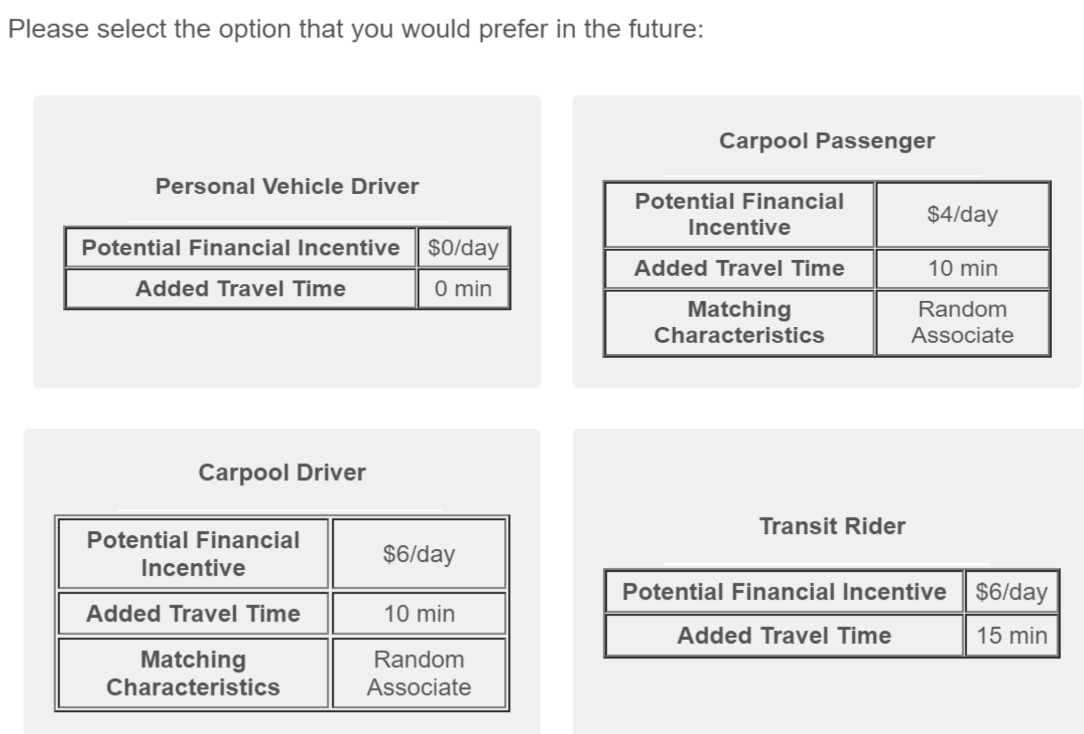


Figure 43: Example Survey Question

Prior to the SP section of the survey, respondents were educated on the implicit assumptions within each alternative. The section sought to allow respondents to assess the increased or decreased utility associated with each explicitly manipulated attribute while holding all other variables constant. For that reason, the following information was provided[3]:

"*The next section of the survey is meant for you to CHOOSE your preferred way to commute to and from work. You will see* ***8 different combinations*** *of alternatives that let you choose between* ***driving your personal vehicle, carpooling (by driver or passenger), and riding transit (rail or bus)****. The modes of commuting will remain the same, but the following aspects will change for each question.*

- ***Financial incentive****: $2, $4, $6, or $8 per day paid to you by your employer*
- ***Added travel time to your commute****: 0 – 30 min of additional commute time per day*
- ***How you will be matched with a carpool partner****: Personal interests, job type, demographic preferences (age, gender), or randomly*

Please choose the option that you would prefer, taking all aspects into consideration. *Each choice is different, so be sure to read all options. Please note that these are hypothetical scenarios, simply intended to inform us of your preferences.*

You can assume the following for each commuting mode:

[3] Note that company-specific language has been changed to preserve employer anonymity.

- ***Carpool Driver –*** *You will always be paired with a company colleague, you can match morning and evening trips with different partners, and you will have a priority parking spot available at the work site*
- ***Carpool Passenger -*** *You will always be paired with a company colleague, you are guaranteed a free ride home (in case of emergency, driver cancellation, etc.), and you will have a priority parking spot available at the work site*
- ***Transit Rider –*** *You can use the company shuttle to travel between public transit and the work site"*

6.5.1 Preliminary Observations

There were 230 respondents that answered a total of 1,840 SP comparisons. Of the randomized question sets, question set 1 had 59 respondents, question set 2 had 58 respondents, question set 3 had 55 respondents, and question set 4 had 58 respondents. This shows that respondents who started question set 3 dropped out of the survey at a slightly higher rate than the rest of the respondents, but not different enough to be of concern. Out of the 1,840 SP questions that included various combinations of attribute levels, 9.5% (175) of responses were for the carpool driver package, 23.4% (430) were for the carpool passenger package, 21.1% (388) were for the transit package, and 46.0% (847) were for the drive-alone package. This shows that, for almost half of the surveyed population, the perceived disutility of non-SOV commuting outweighs the potential benefits offered by either a financial incentive or carpool ride-matching scheme. Additionally, general observations indicate that transit and carpool passenger commuting incite similar behaviors among survey respondents and carpool driver commuting offers the least favorable response of the four alternatives.

The complete output data were initially manipulated in Microsoft Excel into a format that could more easily be analyzed by a more powerful statistical tool that better supports MNL functionality. The demands of the large dataset prompted the use of ELM as the primary statistical tool. ELM is an "open source click-based graphic user interface", created by Jeff Newman, a researcher at the Georgia Institute of Technology as a precursor to Larch (Newman, Lukin, & Garrow, 2016). The interface is intuitive in nature and presents results in a clear manner, making it a useful tool for initial MNL estimations. The results presented in the next section were obtained after the application of several specifications to the SP data obtained from the survey respondents. The final model best explains the effects of each parameter and incorporates the SP section attributes of each of the commuting mode choice alternatives as well as the socio-demographic and commuting behavior characteristics that were obtained in the other survey sections. The variables were categorized into generic and alternative specific. Generic parameters are used with the variable varies across the mode choices (the generic parameter is then the same across all modes) – Carpool Driver, Carpool Passenger, Transit Rider, and SOV. Because there is no reference alternative, generic parameters provide information about the general utility associated with each factor. In contrast, alternative-specific parameters use a reference alternative to compare the relative effects of each option. Alternative-specific parameter estimates need to be used when the variable (like gender) does not vary across alternatives.

In this case, SOV commuting is the reference alternative, so every alternative-specific parameter estimate displays either the positive or negative effect of the explanatory variable on an individual’s proclivity to engage in the identified behavior. APPENDIX B displays some relevant incremental statistical models for further reference. Table 8 displays the descriptions of each of the parameters used in the final model.

Table 8: Model Parameter Descriptions

Parameter Name	Parameter Description
Generic Parameters	
X_1: Financial Incentive	Interval Variable - The effect of a financial incentive on the travel behavior of commuters
X_2: Additional Travel Time	Interval Variable - The effect of additional travel time to a one-way commute
X_3: Matched by Demographics	Categorical Binary Variable - The effect of carpool partners being matched by demographic (age, gender, etc.) preferences
X_4: Matched by Job Type	Categorical Binary Variable - The effect of carpool partners being matched by similar job types
X_5: Matched by Interests	Categorical Binary Variable - The effect of carpool partners being matched by similar personal interests
Alternative Specific Parameters	
X_6: Male	Categorical Binary Variable - The effect of an individual being a male on their commuting travel choices
X_7: Age	Interval Variable - The effect of an individual's age on their commuting travel choices
X_8: Salary	Interval Variable - The effect of an individual's annual salary on their commuting travel choices
X_9: Free Parking Influence	Ordinal Variable - The effect of the availability of free parking on an individual's commuting travel choices

Table 9 displays the final model statistics used after sifting through various combinations of variables and parameter estimates. This model, accounting for the effects of financial incentive, additional travel time, carpool matching characteristics, gender, age, salary, and the influence of free workplace parking, provides intuitive results. Bolded coefficient values represent parameter effects that are significant at a 95% confidence interval (T-statistic > 1.96 or < -1.96).

Table 9: Final Model Statistics

Model Parameters		Model Statistics	
Generic Parameters		**Coefficient**	**T-statistic**
Financial Incentive		**0.1733**	10.3344***
Additional Travel Time		**-0.0612**	-9.0541***
Matched by Demographics		**0.3307**	2.4552**
Matched by Job Type		0.1292	0.9242
Matched by Interests		0.2592	1.9089*
Alternative Specific Parameters	**Mode Alternative**	**Coefficient**	**T-statistic**
CONSTANT	Carpool Driver	-1.32	-3.3198***
CONSTANT	Carpool Passenger	-0.0498	-0.1889
CONSTANT	Transit Rider	-0.4718	-1.5631
Male	Carpool Driver	**0.6113**	3.4095***
Male	Carpool Passenger	**0.5271**	4.072***
Male	Transit Rider	**0.7267**	5.4762***
Age	Carpool Driver	**-0.2327**	-2.5763***
Age	Carpool Passenger	**-0.3287**	-4.9217***

Age	Transit Rider	**0.1498**	2.3319**
Salary	Carpool Driver	**-0.2329**	-3.4503***
Salary	Carpool Passenger	**-0.1343**	-2.8193***
Salary	Transit Rider	**-0.1768**	-3.6744***
Free Parking Influence	Carpool Driver	**0.2447**	3.6668***

* = 90% CI (|T-statistic| > 1.645), ** = 95% CI (|T-statistic| > 1.96), *** = 99% CI (|T-statistic| > 2.576)

Table 10 displays the summary statistics for the data presented above.

Table 10: Final Model Summary Statistics

Model Statistic	Value
Log Likelihood at Zero	-2550.7816
Log Likelihood at Constants	-2297.8826
Log Likelihood at Convergence	-2133.9473
Rho Squared w.r.t. Zero	0.1634
Rho Squared w.r.t Constants	0.0713
Adjusted Rho Squared w.r.t. Zero	0.1564
Adjusted Rho Squared w.r.t Constants	0.0647
Number of Cases	1840
Number of iterations	16
Estimation status	converged, with contants, with zeros, valid lic.

6.5.2 Model Interpretation

The output in Table 9 shows the effect of several socio-demographic and travel-related variables on an individual's propensity to commute via carpool driver, carpool passenger, or transit. The act of SOV commuting, which for most respondents was their current commute mode, serves as the reference point to which all the other values are compared. For clarity, a negative (-) parameter coefficient indicates a negative relationship between the dependent variable (mode alternative) and the explanatory variable (generic and alternative specific parameters). Conversely, a positive (+) coefficient indicates a positive relationship.

The parameter estimates can be integrated in a utility function to assess the overall utility of a certain alternative, given a series of explanatory variables. The general utility equation (V) is given below.

$$V_i = \alpha_i + \beta_1 X_1 + \beta_2 X_2 + \cdots \beta_9 X_9 + \varepsilon_i$$

Where V = Utility of Alternative, β = Parameter-specific estimate, α = parameter constant, X = Value applied to each variable, and ε is the error term. With that context, a summary of the results is presented below:

6.5.2.1 Generic Parameters

- **Financial Incentive:** The model results indicate that the level of financial incentive has positive influence on the overall travel mode choices of commuters. The estimate of 0.1733 means that every $1 increase in financial incentive causes an overall increase in utility of 0.1733. For example, all other factors held constant, an individual offered $8 per day will experience a relative utility increase of 1.0398 when compared to the same individual offered $2 per day for the same activity (($8*0.1733) – ($2*0.1733) = 1.0398). Generic parameter estimates are particularly informative when compared to the effect of other generic parameters.

- **Additional Travel Time:** The model results indicate that additional travel time has a negative relationship with traveler utility. This is intuitive, as increased travel time is usually viewed as a negative aspect of commuting. The estimate of -0.0612 shows that the overall utility of a mode is only slightly responsive to travel time. However, it should be noted that the range of travel times is significantly wider than the range of financial incentives. For example, the status quo for most commuters is SOV travel, which is assumed to be 0 minutes of additional travel time, and thus the baseline for utility. The highest level of additional travel time provided within the SP alternatives was 30 minutes for a transit rider. Holding all other variables constant, the travel time difference experienced in the shift from SOV to transit would diminish the overall commuter utility by 1.836. In comparing travel time to financial incentive, the SP survey results indicate that 8.5 minutes in additional travel time presents a disutility that can be balanced by the utility from a $3 financial incentive, when all other factors are held constant.

- **Carpool matching characteristics:** The model results indicate an overall positive relationship between targeted carpool matching characteristics when compared to random partner matching. This is consistent with literature that suggests that an individual's likelihood to carpool is diminished if they are partnered with a stranger. The incorporation of specific matching parameters in the survey informs TDM practitioners about the most effective methods of pairing potential carpoolers. The model suggests that respondents much prefer to be partnered by demographic preferences (age, gender, etc.) than by either job type (engineering, staff, manager, retail, etc.) or by personal interests (music, sports, etc.). Demographic preference-based matching (0.3307) is shown to contribute about 27.5% more to overall utility than interest-based matching (0.2592) and 156% more than job type matching (0.1292). It should be noted that matching is only applicable to carpool commuting, so these explanatory variables are with respect to random matching as either a carpool driver or passenger. In a vacuum, survey respondents indicate that being matched by demographic preferences rather than with a random colleague is worth about $1.90 per day, on average. While the results are interesting to compare against one another, the job type matching and interest matching schemes proved to not be statistically significant to the 95% level, meaning that conclusive inferences should not be declared.

6.5.2.2 Alternative Specific Parameters

- **Male:** Gender was applied as a binary variable within the statistical model, with male = 1, and female or other = 0. There were 93 self-identified males, 122 self-identified females, and 15 respondents who abstained from identifying their gender.

While this could present some skewing in the data, that portion only represents 6.5% of the population. The model indicates that males are more likely to participate in non-SOV commute alternatives like carpool (driver and passenger) and transit. This analysis also indicates that being male has a higher mode utility boost for transit than either carpooling alternative, suggesting that a carpool-targeted TDM initiative would cater more to both men and women than a transit-focused program that more exclusively targets men.

- **Age:** Age was applied as an interval parameter within the model, with evenly spaced categories (~10-year range). The model estimates show effect estimates of -0.2327 for carpool driver, -0.3287 for carpool passenger, and 0.1498 for transit rider, relative to the SOV reference. Interestingly, these data suggest that, all else held constant, a 10-year increase in age of a traveler reduces their perceived utility of commuting by carpool but increases their perceived utility of commuting by transit. Theoretically, an employer could offer different level financial incentives to compensate for varying effects of age on commute preferences and maintain similar uptake. This dynamic highlights the different modal preferences across age groups, demonstrating that younger employees are most amenable to carpool-associated technology needs and logistical complexity.
- **Salary:** Salary, though intuitively closely correlated with age, presents unique effects within the model, and was therefore considered in the final analysis. Salary was applied as an interval variable, with $30,000 serving as the category range. The

model, for which all salary coefficients were significant to the 99% level, shows that salary has a negative relationship with all three response variables. With respect to carpool behavior, the model indicates that a $30,000 per year increase in salary correlates to utility values of -0.2329 and -0.1343 for carpool driver and carpool passenger packages, respectively.

- **Free parking influence:** Free parking at the work site influences commuting decisions to some extent. The level to which the parking situation affects commuter behaviors varies across employees. In the model, the ordinal variable was applied only to the carpool driver package, with SOV remaining the reference point. Responses included "does not influence", "slightly influences", "moderately influences", and "heavily influences". The results indicate that free parking has a positive relationship with the carpool driver response variable, which is intuitive. The coefficient of 0.2447 can be interpreted to mean that as a respondent becomes increasingly responsive to free parking at the work site, they experience a 0.2447 increase in carpool driver utility. While this relationship is not as clear as some of the other explanatory variables, it gives an indication of the potential influence of free parking on employee commute choices.

Table 11 displays the intra-alternative effects of various explanatory variables like gender, age, salary, and the influence of free parking on an individual's propensity to engage in the alternative. This analysis was conducted using a basic conditional odds ratio equation:

$$P = e^{\beta_i X_k}$$

Where P = relative likelihood of choosing that alternative, β_i = coefficient of the alternative, and X_k = the attribute level studied.

Table 11: Alternative Specific Parameter Effects Across Attribute Levels

Attribute Levels from Reference						
			Male	--	--	--
			10-year age increase	20-year age increase	30-year age increase	--
			$30,000 salary increase	$60,000 salary increase	$90,000 salary increase	$120,000 salary increase
			1 category increase in influence of free parking	2 category increase in influence of free parking	3 category increase in influence of free parking	--
Attribute	Coefficient	Alternative	1	2	3	4
Gender	0.6113	Carpool Driver	**1.84**	--	--	--
	0.5271	Carpool Passenger	**1.69**	--	--	--
	0.7267	Transit Rider	**2.07**	--	--	--
Age	-0.2327	Carpool Driver	**-1.26**	-1.59	-2.01	--
	-0.3287	Carpool Passenger	**-1.39**	-1.93	-2.68	--
	0.1498	Transit Rider	**1.16**	1.35	1.57	--
Salary	-0.2329	Carpool Driver	**-1.26**	-1.59	-2.01	-2.54
	-0.1343	Carpool Passenger	**-1.14**	-1.31	-1.50	-1.71
	-0.1768	Transit Rider	**-1.19**	-1.42	-1.70	-2.03
Parking influence	0.2447	Carpool Driver	**1.28**	1.63	2.08	--

Note that the values presented are relative to an arbitrary reference point, other than gender, for which male is in reference to female/other. The attribute levels from reference are denoted at the top of the table, showing the effect that various levels have on travel behavior. A positive sign correlates to an individual being more likely to engage in an alternative given the attribute levels within the same column. A negative sign correlates to an individual being less likely to engage in the corresponding alternative. For instance, the bolded column in Table 11 shows the following:

- A male, compared to a non-male, is 1.84 times more likely to be a carpool driver, 1.69 times more likely to be a carpool passenger, and 2.07 times more likely to be a transit rider.
- A 10-year age increase in an individual makes them 1.26 times less likely to be a carpool driver, 1.39 times less likely to be a carpool passenger, but 1.16 times more likely to be a transit rider.
- A $30,000 per year salary increase makes an individual 1.26 times less likely to be a carpool driver, 1.14 times less likely to be a carpool passenger, and 1.19 times less likely to be a transit rider.
- A one-category shift in perceived level of influence of free work place parking makes an individual 1.28 times more likely to be a carpool driver.

This analysis has limitations. Firstly, the relationship between utility and probability is non-linear, meaning that the analysis cannot be applied across all attribute levels evenly. In other words, an age increase from age 30 to age 40 does not have the same effect as an age increase from age 40 to age 50. However, the analysis presents an interesting step toward understanding alternative specific attribute effects. Additionally, this analysis assumes that the effects of these attribute levels are considered in isolation, where in reality that is extremely unlikely. Finally, advanced modeling techniques such as mixed logit could have been used to accommodate the multiple responses from a single individual, however that will have more of an impact on t-statistics than parameter estimates.

CHAPTER 7: CONCLUSION

Transportation systems in United States' cities are in downward spiral regarding efficiency, safety, and quality of life. As urbanization brings in additional people and the American car-centric mindset remains prevalent, travel choices could have significant impacts on the economic, environmental, and social future of the nation. Commuting trips are a significant source of congestion within transportation networks today, with 88% of commuters using a personal vehicle and concentrating their travel within morning and afternoon peak times. This behavior contributes to the aforementioned negative impacts along with negative employee experience that can remain with them throughout the work day.

Employer-based TDM has emerged as an effective way to combat car-dependency among employees and improve employee well-being while saving employers additional parking structure investment. It revolves around the concept that creating alternative travel options for commuters and incentivizing them to use them can change established employee travel behaviors. The social, environmental, and business benefits make employer-based TDM popular in many major corporations.

The effectiveness of a TDM program is contingent on the level of familiarity an employer has with its employees' predilections and barriers. These attitudes vary across socio-demographic groups and other personal characteristics. While there has been significant research into the specific barriers contributing to overwhelming car-dependency, the specific effect that those barriers have on travel behavior is an understudied aspect of TDM.

This analysis, through the implementation of a comprehensive employee survey at a major Atlanta employer, evaluated the relationship between employee-identified non-SOV commute barriers and the potential employer-provided incentives that could be utilized to overcome them. The evaluation found that money is influential as a driver of behavior change, but that the level to which it is influential varies across personal characteristics like age, gender, salary, current commuting time and distance.

The major takeaways from this research show that even though an overwhelming majority of employees drive alone to work, there is a significant portion of them that seem to be malleable in their behavior, indicated by the 33.5% multi-modality rate (respondents whose primary mode is SOV, but who also used other modes on occasion) and 34% of respondents who are heavily influenced by the availability of free workplace parking. This is the group that can be effectively targeted by employer TDM initiatives and encouraged to take alternative modes like transit or carpool. The analysis shows that young, wealthy males are the most multi-modal group, and thus the most likely to participate in a mode shift. Regarding transit, the data show that women have a decreased likelihood to take transit due to reliability and flexibility sensitivities, especially middle-aged women who have an increased need for trip chaining. The carpool-eligible population (those that could possibly be converted through an employer-provided carpool service) comprises 23% of the worksite, while primary barriers are the need for personal autonomy and irregular working hours. Older employees tend to work more irregular hours, meaning that carpool caters primarily to young males, as long as there is immediate feedback within the application. Females have similar barriers regarding flexibility that seem to decrease their willingness to participate.

One of the more interesting findings from the survey comes from the discrete choice model developed using the stated preference responses (SOV, transit, carpool driver, carpool passenger). The statistical model provided interesting results about the independent effects of each parameter. It was found that every dollar of financial incentive was roughly worth an additional 8.5 minutes in travel time. Furthermore, within carpool matching, the data show that people desire to ride with someone of their preferred age and gender, a desire that is shown to be worth \$1.90 per day to the study sample. While using caution due to model limitations, the analysis indicated that a male, compared to a non-male, is 1.84 times more likely to be a carpool driver, 1.69 times more likely to be a carpool passenger, and 2.07 times more likely to be a transit rider. A 10-year age increase in an individual makes them 1.26 times less likely to be a carpool driver, 1.39 times less likely to be a carpool passenger, but 1.16 times more likely to be a transit rider. A \$30,000 per year salary increase makes an individual 1.26 times less likely to be a carpool driver, 1.14 times less likely to be a carpool passenger, and 1.19 times less likely to be a transit rider. A one-category shift in perceived level of influence of free work place parking makes an individual 1.28 times more likely to be a carpool driver.

Though the case study is unique to Atlanta, GA and the specific study corporation, the major takeaways are largely transferable to corporations with similar work site makeup and geographical and transportation landscapes. This analysis offers value to the field of corporate TDM by providing a contemporary reference point for TDM practitioners. As the knowledge about employer-based TDM grows, so will the employer's ability to target programmatic and financial resources in the most effective way for their specific work site needs.

APPENDIX A

Current Commuting Characteristics

Privacy Notice: Participation in this survey is **optional** and your responses are kept confidential. We will only collect your responses and not retain any information directly identifiable to you. Your unique link to access this survey is tied to your email address and only demonstrates whether or not you have participated in this survey. Your responses are not recorded with your email address. If you have any questions, please contact: CONFIDENTIAL.com. Please select the arrow to continue.

How many miles (estimated) do you live from CONFIDENTIAL

How many minutes does your typical commute to work take you?*

On days that you come to work, how do you primarily commute?*

Please describe your choice of "other" for your primary commute mode.

If you sometimes come to work using a different mode of transportation, what is your secondary way of commuting?*

Please describe your choice of "other" for your secondary commute mode.

How much (in dollars) do you feel like you spend on your commute to and from work **per month** (considering gas, insurance, and vehicle wear and tear)?*

Commuting Values

What is the *primary reason* you don't use public transit (MARTA, GRTA Xpress, Cobb Linc, Gwinnett County Transit) for more of your trips?*

Please describe your choice of "other" for the primary reason you don't use transit.

What is the *primary reason* you don't use carpool for more of your trips?*

Please describe your choice of "other" for the primary reason you don't carpool.

Here at CONFIDENTIAL we are very proud to be able to offer parking to associates. Please indicate to what extent the availability of parking influences your commuting choices.*

Does not influence	Slightly influences	Moderately influences	Heavily influences
○	○	○	○

Commuting Choice Preference (Block 1)

The next section of the survey is meant for you to CHOOSE your preferred way to commute to CONFIDENTIAL You will see **8 different combinations** of alternatives and each will ask you to choose between:

- ***Driving your personal vehicle***
- ***Carpooling (by driver or passenger)***
    - **Carpool Driver** – Assume you will always be paired with a CONFIDENTIAL colleague, you can match morning and evening trips with different partners, and you will have a priority parking spot available
    - **Carpool Passenger** – Assume you will always be paired with a CONFIDENTIAL colleague, you are guaranteed a free ride home (in case of emergency, driver cancellation, etc.), and you will have a priority parking spot available
- ***Riding transit (rail or bus) –*** assumes the CONFIDENTIAL shuttle remains for travel between CONFIDENTIAL and CONFIDENTIAL station

These 3 modes of commuting will remain the same, but the following aspects will change for each question:

- ***Potential financial incentives***: $2, $4, $6, or $8 per day paid to you by CONFIDENTIAL
- ***Added travel time to your commute:*** 0 – 30 min of additional commute time per day
- ***How you will be matched with a carpool partner***: Personal interests, job type, demographic preferences (age, gender), or randomly

Please choose the option that you would prefer, taking all aspects into consideration. Each choice is different, so be sure to read all options. Please note that these are <u>hypothetical scenarios at this point</u>, simply intended to inform us of your preferences.

Please select the option that you would prefer in the future:

○ **Personal Vehicle Driver**

Potential Financial Incentive	$0/day
Added Travel Time	0 min

○ **Carpool Passenger**

Potential Financial Incentive	$6/day
Added Travel Time	15 min
Matching Characteristics	Demographics

○ **Carpool Driver**

Potential Financial Incentive	$6/day

○ **Transit Rider**

Potential Financial Incentive	$2/day

Incentive	[illegible]
Added Travel Time	20 min
Matching Characteristics	Random Associate

Added Travel Time	20 min

Matching Characteristics:

- **Job Type** matches you with CONFIDENTIAL colleague with a similar job type as you
- **Interests** matches you with someone of similar interests to you, based on compatibility measures
- **Demographics** matches you with someone based on your age and gender preferences

Please select the option that you would prefer in the future:

Personal Vehicle Driver

Potential Financial Incentive	$0/day
Added Travel Time	0 min

Carpool Passenger

Potential Financial Incentive	$4/day
Added Travel Time	10 min
Matching Characteristics	Random Associate

Carpool Driver

Potential Financial Incentive	$6/day
Added Travel Time	10 min
Matching Characteristics	Random Associate

Transit Rider

Potential Financial Incentive	$6/day
Added Travel Time	15 min

Matching Characteristics:

- **Job Type** matches you with CONFIDENTIAL colleague with a similar job type as you
- **Interests** matches you with someone of similar interests to you, based on compatibility measures
- **Demographics** matches you with someone based on your age and gender preferences

Please select the option that you would prefer in the future:

Personal Vehicle Driver

Potential Financial Incentive	$0/day
Added Travel Time	0 min

Carpool Passenger

Potential Financial Incentive	$8/day
Added Travel Time	10 min
Matching Characteristics	Interests

Carpool Driver

Potential Financial Incentive	$2/day
Added Travel Time	5 min
Matching Characteristics	Interests

Transit Rider

Potential Financial Incentive	$6/day
Added Travel Time	30 min

Matching Characteristics:

- **Job Type** matches you with CONFIDENTIAL colleague with a similar job type as you
- **Interests** matches you with someone of similar interests to you, based on compatibility measures
- **Demographics** matches you with someone based on your age and gender preferences

Please select the option that you would prefer in the future:

Personal Vehicle Driver

Potential Financial Incentive	$0/day
Added Travel Time	0 min

Carpool Passenger

Potential Financial Incentive	$8/day
Added Travel Time	5 min
Matching Characteristics	Demographics

Carpool Driver

Potential Financial Incentive	$4/day
Added Travel Time	5 min
Matching Characteristics	Job Type

Transit Rider

Potential Financial Incentive	$8/day
Added Travel Time	20 min

Matching Characteristics:

- **Job Type** matches you with CONFIDENTIAL colleague with a similar job type as you
- **Interests** matches you with someone of similar interests to you, based on compatibility measures
- **Demographics** matches you with someone based on your age and gender preferences

Please select the option that you would prefer in the future:

○ **Personal Vehicle Driver**

Potential Financial Incentive	$0/day
Added Travel Time	0 min

○ **Carpool Passenger**

Potential Financial Incentive	$2/day
Added Travel Time	15 min
Matching Characteristics	Job Type

○ **Carpool Driver**

Potential Financial Incentive	$2/day
Added Travel Time	15 min
Matching Characteristics	Interests

○ **Transit Rider**

Potential Financial Incentive	$2/day
Added Travel Time	25 min

Matching Characteristics:

- **Job Type** matches you with CONFIDENTIAL colleague with a similar job type as you
- **Interests** matches you with someone of similar interests to you, based on compatibility measures
- **Demographics** matches you with someone based on your age and gender preferences

Please select the option that you would prefer in the future:

○ **Personal Vehicle Driver**

Potential Financial Incentive	$0/day
Added Travel Time	0 min

○ **Carpool Passenger**

Potential Financial Incentive	$6/day
Added Travel Time	0 min
Matching Characteristics	Interests

○ **Carpool Driver**

Potential Financial Incentive	$8/day
Added Travel Time	20 min
Matching Characteristics	Demographics

○ **Transit Rider**

Potential Financial Incentive	$2/day
Added Travel Time	20 min

Matching Characteristics:

- **Job Type** matches you with CONFIDENTIAL colleague with a similar job type as you
- **Interests** matches you with someone of similar interests to you, based on compatibility measures

- **Demographics** matches you with someone based on your age and gender preferences

Please select the option that you would prefer in the future:

○ **Personal Vehicle Driver**

Potential Financial Incentive	$0/day
Added Travel Time	0 min

○ **Carpool Passenger**

Potential Financial Incentive	$4/day
Added Travel Time	5 min
Matching Characteristics	Job Type

○ **Carpool Driver**

Potential Financial Incentive	$8/day
Added Travel Time	10 min
Matching Characteristics	Demographics

○ **Transit Rider**

Potential Financial Incentive	$8/day
Added Travel Time	25 min

Matching Characteristics:

- **Job Type** matches you with CONFIDENTIAL colleague with a similar job type as you
- **Interests** matches you with someone of similar interests to you, based on compatibility measures
- **Demographics** matches you with someone based on your age and gender preferences

Please select the option that you would prefer in the future:

○ **Personal Vehicle Driver**

Potential Financial Incentive	$0/day
Added Travel Time	0 min

○ **Carpool Passenger**

Potential Financial Incentive	$2/day
Added Travel Time	0 min
Matching Characteristics	Random Associate

○ **Carpool Driver**

Potential Financial Incentive	$4/day
Added Travel Time	15 min
Matching Characteristics	Job Type

○ **Transit Rider**

Potential Financial Incentive	$4/day
Added Travel Time	15 min

Commuting Choice Preference (Block 2)

The next section of the survey is meant for you to CHOOSE your preferred way to commute to CONFIDENTIAL. You will see **8 different combinations** of alternatives and each will ask you to choose between:

- ***Driving your personal vehicle***
- ***Carpooling (by driver or passenger)***
  - **Carpool Driver** – Assume you will always be paired with a CONFIDENTIAL colleague, you can match morning and evening trips with different partners, and you will have a priority parking spot available
  - **Carpool Passenger** – Assume you will always be paired with a CONFIDENTIAL colleague, you are guaranteed a free ride home (in case of emergency, driver cancellation, etc.), and you will have a priority parking spot available
- ***Riding transit (rail or bus) –*** assumes the CONFIDENTIAL shuttle remains for travel between CONFIDENTIAL and CONFIDENTIAL station

These 3 modes of commuting will remain the same, but the following aspects will change for each question:

- ***Potential financial incentives***: $2, $4, $6, or $8 per day paid to you by CONFIDENTIAL
- ***Added travel time to your commute****:* 0 – 30 min of additional commute time per day
- ***How you will be matched with a carpool partner***: Personal interests, job type, demographic preferences (age, gender), or randomly

Please choose the option that you would prefer, taking all aspects into consideration. Each choice is different, so be sure to read all options. Please note that these are <u>hypothetical scenarios at this point</u>, simply intended to inform us of your preferences.

Please select the option that you would prefer in the future::

○ **Personal Vehicle Driver** ○ **Carpool Passenger**

Potential Financial Incentive	$0/day
Added Travel Time	0 min

Potential Financial Incentive	$6/day
Added Travel Time	5 min
Matching Characteristics	Interests

Carpool Driver

Potential Financial Incentive	$6/day
Added Travel Time	15 min
Matching Characteristics	Job Type

Transit Rider

Potential Financial Incentive	$6/day
Added Travel Time	25 min

Matching Characteristics:

- **Job Type** matches you with an CONFIDENTIAL olleague with a similar job type as you
- **Interests** matches you with someone of similar interests to you, based on compatibility measures
- **Demographics** matches you with someone based on your age and gender preferences

Please select the option that you would prefer in the future:

Personal Vehicle Driver

Potential Financial Incentive	$0/day
Added Travel Time	0 min

Carpool Passenger

Potential Financial Incentive	$6/day
Added Travel Time	0 min
Matching Characteristics	Job Type

Carpool Driver

Potential Financial Incentive	$4/day
Added Travel Time	10 min
Matching Characteristics	Interests

Transit Rider

Potential Financial Incentive	$6/day
Added Travel Time	20 min

Matching Characteristics:

- **Job Type** matches you with CONFIDENTIAL colleague with a similar job type as you
- **Interests** matches you with someone of similar interests to you, based on compatibility measures
- **Demographics** matches you with someone based on your age and gender preferences

Please select the option that you would prefer in the future:

Personal Vehicle Driver

Potential Financial Incentive	$0/day
Added Travel Time	0 min

Carpool Passenger

Potential Financial Incentive	$2/day
Added Travel Time	10 min
Matching Characteristics	Job Type

Carpool Driver

Potential Financial Incentive	$4/day
Added Travel Time	20 min
Matching Characteristics	Random Associate

Transit Rider

Potential Financial Incentive	$8/day
Added Travel Time	30 min

Matching Characteristics:

- **Job Type** matches you with CONFIDENTIAL colleague with a similar job type as you
- **Interests** matches you with someone of similar interests to you, based on compatibility measures
- **Demographics** matches you with someone based on your age and gender preferences

Please select the option that you would prefer in the future:

Personal Vehicle Driver

Potential Financial Incentive	$0/day
Added Travel Time	0 min

Carpool Passenger

Potential Financial Incentive	$8/day
Added Travel Time	5 min
Matching Characteristics	Random Associate

Carpool Driver

Potential Financial Incentive	$8/day
Added Travel Time	15 min
Matching Characteristics	Random Associate

Transit Rider

Potential Financial Incentive	$2/day
Added Travel Time	30 min

Matching Characteristics:

- **Job Type** matches you with CONFIDENTIAL colleague with a similar job type as you

- **Interests** matches you with someone of similar interests to you, based on compatibility measures
- **Demographics** matches you with someone based on your age and gender preferences

Please select the option that you would prefer in the future:

Personal Vehicle Driver

Potential Financial Incentive	$0/day
Added Travel Time	0 min

Carpool Passenger

Potential Financial Incentive	$4/day
AddedTravel Time	15 min
Matching Characteristics	Random Associate

Carpool Driver

Potential Financial Incentive	$8/day
Added Travel Time	5 min
Matching Characteristics	Interests

Transit Rider

Potential Financial Incentive	$2/day
Added Travel Time	25 min

Matching Characteristics:

- **Job Type** matches you with CONFIDENTIAL colleague with a similar job type as you
- **Interests** matches you with someone of similar interests to you, based on compatibility measures
- **Demographics** matches you with someone based on your age and gender preferences

Please select the option that you would prefer in the future:

Personal Vehicle Driver

Potential Financial Incentive	$0/day
Added Travel Time	0 min

Carpool Passenger

Potential Financial Incentive	$8/day
Added Travel Time	0 min
Matching Characteristics	Demographics

Carpool Driver

Potential Financial Incentive	$2/day
Added Travel Time	10 min
Matching Characteristics	Demographics

Transit Rider

Potential Financial Incentive	$2/day
Added Travel Time	15 min

Matching Characteristics	Demographics

Matching Characteristics:

- **Job Type** matches you with CONFIDENTIAL colleague with a similar job type as you
- **Interests** matches you with someone of similar interests to you, based on compatibility measures
- **Demographics** matches you with someone based on your age and gender preferences

Please select the option that you would prefer in the future:

Personal Vehicle Driver

Potential Financial Incentive	$0/day
Added Travel Time	0 min

Carpool Passenger

Potential Financial Incentive	$4/day
Added Travel Time	5 min
Matching Characteristics	Job Type

Carpool Driver

Potential Financial Incentive	$2/day
Added Travel Time	20 min
Matching Characteristics	Job Type

Transit Rider

Potential Financial Incentive	$8/day
Added Travel Time	25 min

Matching Characteristics:

- **Job Type** matches you with CONFIDENTIAL colleague with a similar job type as you
- **Interests** matches you with someone of similar interests to you, based on compatibility measures
- **Demographics** matches you with someone based on your age and gender preferences

Please select the option that you would prefer in the future:

Personal Vehicle Driver

Potential Financial Incentive	$0/day
Added Travel Time	0 min

Carpool Passenger

Potential Financial Incentive	$2/day
Added Travel Time	15 min
Matching Characteristics	Interests

Carpool Driver

Potential Financial	$6/day

Transit Rider

Potential Financial Incentive	$4/day

Incentive	[illegible]/day
Added Travel Time	5 min
Matching Characteristics	Demographics

Added Travel Time	15 min

Commuting Choice Preference (Block 3)

The next section of the survey is meant for you to CHOOSE your preferred way to commute to CONFIDENTIAL. You will see **8 different combinations** of alternatives and each will ask you to choose between:

- ***Driving your personal vehicle***
- ***Carpooling (by driver or passenger)***
    - **Carpool Driver** – Assume you will always be paired with a CONFIDENTIAL colleague, you can match morning and evening trips with different partners, and you will have a priority parking spot available
    - **Carpool Passenger** – Assume you will always be paired with a CONFIDENTIAL colleague, you are guaranteed a free ride home (in case of emergency, driver cancellation, etc.), and you will have a priority parking spot available
- ***Riding transit (rail or bus)* –** assumes the CONFIDENTIAL shuttle remains for travel between CONFIDENTIAL and CONFIDENTIAL station

These 3 modes of commuting will remain the same, but the following aspects will change for each question:

- ***Potential financial incentives***: $2, $4, $6, or $8 per day paid to you by CONFIDENTIAL
- ***Added travel time to your commute**:* 0 – 30 min of additional commute time per day
- ***How you will be matched with a carpool partner***: Personal interests, job type, demographic preferences (age, gender), or randomly

Please choose the option that you would prefer, taking all aspects into consideration. Each choice is different, so be sure to read all options. Please note that these are <u>hypothetical scenarios at this point</u>, simply intended to inform us of your preferences.

Please select the option that you would prefer in the future:

Personal Vehicle Driver

Potential Financial Incentive	$0/day
Added Travel Time	0 min

Carpool Passenger

Potential Financial Incentive	$2/day
Added Travel Time	0 min
Matching Characteristics	Demographics

Carpool Driver

Potential Financial Incentive	$8/day
Added Travel Time	5 min
Matching Characteristics	Random Associate

Transit Rider

Potential Financial Incentive	$6/day
Added Travel Time	25 min

Matching Characteristics:

- **Job Type** matches you with CONFIDENTIAL colleague with a similar job type as you
- **Interests** matches you with someone of similar interests to you, based on compatibility measures
- **Demographics** matches you with someone based on your age and gender preferences

Please select the option that you would prefer in the future:

Personal Vehicle Driver

Potential Financial Incentive	$0/day
Added Travel Time	0 min

Carpool Passenger

Potential Financial Incentive	$4/day
Added Travel Time	5 min
Matching Characteristics	Interests

Carpool Driver

Potential Financial Incentive	$4/day
Added Travel Time	20 min
Matching Characteristics	Interests

Transit Rider

Potential Financial Incentive	$2/day
Added Travel Time	15 min

Matching Characteristics:

- **Job Type** matches you with CONFIDENTIAL colleague with a similar job type as you

- **Interests** matches you with someone of similar interests to you, based on compatibility measures
- **Demographics** matches you with someone based on your age and gender preferences

Please select the option that you would prefer in the future:

Personal Vehicle Driver

Potential Financial Incentive	$0/day
Added Travel Time	0 min

Carpool Passenger

Potential Financial Incentive	$8/day
Added Travel Time	15 min
Matching Characteristics	Interests

Carpool Driver

Potential Financial Incentive	$4/day
Added Travel Time	10 min
Matching Characteristics	Random Associate

Transit Rider

Potential Financial Incentive	$4/day
Added Travel Time	25 min

Matching Characteristics:

- **Job Type** matches you with CONFIDENTIAL colleague with a similar job type as you
- **Interests** matches you with someone of similar interests to you, based on compatibility measures
- **Demographics** matches you with someone based on your age and gender preferences

Please select the option that you would prefer in the future:

Personal Vehicle Driver

Potential Financial Incentive	$0/day
Added Travel Time	0 min

Carpool Passenger

Potential Financial Incentive	$2/day
Added Travel Time	5 min
Matching Characteristics	Random Associate

Carpool Driver

Potential Financial Incentive	$2/day
Added Travel Time	20 min

Transit Rider

Potential Financial Incentive	$6/day
Added Travel Time	20 min

Matching Characteristics	Demographics

Matching Characteristics:

- **Job Type** matches you with CONFIDENTIAL colleague with a similar job type as you
- **Interests** matches you with someone of similar interests to you, based on compatibility measures
- **Demographics** matches you with someone based on your age and gender preferences

Please select the option that you would prefer in the future:

Personal Vehicle Driver

Potential Financial Incentive	$0/day
Added Travel Time	0 min

Carpool Passenger

Potential Financial Incentive	$6/day
Added Travel Time	10 min
Matching Characteristics	Demographics

Carpool Driver

Potential Financial Incentive	$8/day
Added Travel Time	15 min
Matching Characteristics	Interests

Transit Rider

Potential Financial Incentive	$8/day
Added Travel Time	15 min

Matching Characteristics:

- **Job Type** matches you with CONFIDENTIAL colleague with a similar job type as you
- **Interests** matches you with someone of similar interests to you, based on compatibility measures
- **Demographics** matches you with someone based on your age and gender preferences

Please select the option that you would prefer in the future:

Personal Vehicle Driver

Potential Financial Incentive	$0/day
Added Travel Time	0 min

Carpool Passenger

Potential Financial Incentive	$6/day
Added Travel Time	15 min
Matching	Random

Characteristics	Associate

Carpool Driver

Potential Financial Incentive	$2/day
Added Travel Time	10 min
Matching Characteristics	Job Type

Transit Rider

Potential Financial Incentive	$8/day
Added Travel Time	30 min

Matching Characteristics:

- **Job Type** matches you with CONFIDENTIAL colleague with a similar job type as you
- **Interests** matches you with someone of similar interests to you, based on compatibility measures
- **Demographics** matches you with someone based on your age and gender preferences

Please select the option that you would prefer in the future:

Personal Vehicle Driver

Potential Financial Incentive	$0/day
Added Travel Time	0 min

Carpool Passenger

Potential Financial Incentive	$4/day
Added Travel Time	0 min
Matching Characteristics	Job Type

Carpool Driver

Potential Financial Incentive	$6/day
Added Travel Time	5 min
Matching Characteristics	Job Type

Transit Rider

Potential Financial Incentive	$2/day
Added Travel Time	30 min

Matching Characteristics:

- **Job Type** matches you with CONFIDENTIAL colleague with a similar job type as you
- **Interests** matches you with someone of similar interests to you, based on compatibility measures
- **Demographics** matches you with someone based on your age and gender preferences

Please select the option that you would prefer in the future:

Personal Vehicle Driver

Carpool Passenger

Potential Financial Incentive	$0/day
Added Travel Time	0 min

Potential Financial Incentive	$8/day
Added Travel Time	10 min
Matching Characteristics	Job Type

Carpool Driver

Potential Financial Incentive	$6/day
Added Travel Time	15 min
Matching Characteristics	Demographics

Transit Rider

Potential Financial Incentive	$4/day
Added Travel Time	20 min

Commuting Choice Preference (Block 4)

The next section of the survey is meant for you to CHOOSE your preferred way to commute to CONFIDENTIAL You will see **8 different combinations** of alternatives and each will ask you to choose between:

- ***Driving your personal vehicle***
- ***Carpooling (by driver or passenger)***
  - **Carpool Driver** – Assume you will always be paired with a CONFIDENTIAL colleague, you can match morning and evening trips with different partners, and you will have a priority parking spot available
  - **Carpool Passenger** – Assume you will always be paired with a CONFIDENTIAL colleague, you are guaranteed a free ride home (in case of emergency, driver cancellation, etc.), and you will have a priority parking spot available
- ***Riding transit (rail or bus) –*** assumes the CONFIDENTIAL shuttle remains for travel between CONFIDENTIAL and CONFIDENTIAL station

These 3 modes of commuting will remain the same, but the following aspects will change for each question:

- ***Potential financial incentives***: $2, $4, $6, or $8 per day paid to you by CONFIDENTIAL
- ***Added travel time to your commute****:* 0 – 30 min of additional commute time per day
- ***How you will be matched with a carpool partner***: Personal interests, job type, demographic preferences (age, gender), or randomly

Please choose the option that you would prefer, taking all aspects into consideration. Each choice is different, so be sure to read all options. Please note that these are hypothetical scenarios at this point, simply intended to inform us of your preferences.

Please select the option that you would prefer in the future:

○ **Personal Vehicle Driver**

Potential Financial Incentive	$0/day
Added Travel Time	0 min

○ **Carpool Passenger**

Potential Financial Incentive	$6/day
Added Travel Time	10 min
Matching Characteristics	Random Associate

○ **Carpool Driver**

Potential Financial Incentive	$4/day
Added Travel Time	5 min
Matching Characteristics	Demographics

○ **Transit Rider**

Potential Financial Incentive	$2/day
Added Travel Time	25 min

Matching Characteristics:

- **Job Type** matches you with CONFIDENTIAL colleague with a similar job type as you
- **Interests** matches you with someone of similar interests to you, based on compatibility measures
- **Demographics** matches you with someone based on your age and gender preferences

Please select the option that you would prefer in the future:

○ **Personal Vehicle Driver**

Potential Financial Incentive	$0/day
Added Travel Time	0 min

○ **Carpool Passenger**

Potential Financial Incentive	$8/day
Added Travel Time	0 min
Matching Characteristics	Random Associate

○ **Carpool Driver**

Potential Financial Incentive	$6/day

○ **Transit Rider**

Potential Financial Incentive	$8/day

Added Travel Time	20 min
Matching Characteristics	Interests

Added Travel Time	25 min

Matching Characteristics:

- **Job Type** matches you with [redacted] colleague with a similar job type as you
- **Interests** matches you with someone of similar interests to you, based on compatibility measures
- **Demographics** matches you with someone based on your age and gender preferences

Please select the option that you would prefer in the future:

Personal Vehicle Driver

Potential Financial Incentive	$0/day
Added Travel Time	0 min

Carpool Passenger

Potential Financial Incentive	$2/day
Added Travel Time	5 min
Matching Characteristics	Demographics

Carpool Driver

Potential Financial Incentive	$6/day
Added Travel Time	10 min
Matching Characteristics	Interests

Transit Rider

Potential Financial Incentive	$4/day
Added Travel Time	30 min

Matching Characteristics:

- **Job Type** matches you with [redacted] colleague with a similar job type as you
- **Interests** matches you with someone of similar interests to you, based on compatibility measures
- **Demographics** matches you with someone based on your age and gender preferences

Please select the option that you would prefer in the future:

Personal Vehicle Driver

Potential Financial Incentive	$0/day
Added Travel Time	0 min

Carpool Passenger

Potential Financial Incentive	$8/day
Added Travel Time	15 min
Matching Characteristics	Job Type

Carpool Driver

Potential Financial Incentive	$8/day
Added Travel Time	20 min
Matching Characteristics	Job Type

Transit Rider

Potential Financial Incentive	$6/day
Added Travel Time	15 min

Matching Characteristics:

- **Job Type** matches you with CONFIDENTIAL colleague with a similar job type as you
- **Interests** matches you with someone of similar interests to you, based on compatibility measures
- **Demographics** matches you with someone based on your age and gender preferences

Please select the option that you would prefer in the future:

Personal Vehicle Driver

Potential Financial Incentive	$0/day
Added Travel Time	0 min

Carpool Passenger

Potential Financial Incentive	$6/day
Added Travel Time	5 min
Matching Characteristics	Job Type

Carpool Driver

Potential Financial Incentive	$2/day
Added Travel Time	5 min
Matching Characteristics	Random Associate

Transit Rider

Potential Financial Incentive	$4/day
Added Travel Time	15 min

Matching Characteristics:

- **Job Type** matches you with CONFIDENTIAL colleague with a similar job type as you
- **Interests** matches you with someone of similar interests to you, based on compatibility measures
- **Demographics** matches you with someone based on your age and gender preferences

Please select the option that you would prefer in the future:

Personal Vehicle Driver

Carpool Passenger

Potential Financial Incentive	$0/day
Added Travel Time	0 min

Potential Financial Incentive	$2/day
Added Travel Time	10 min
Matching Characteristics	Interests

Carpool Driver

Potential Financial Incentive	$8/day
Added Travel Time	10 min
Matching Characteristics	Job Type

Transit Rider

Potential Financial Incentive	$2/day
Added Travel Time	20 min

Matching Characteristics:

- **Job Type** matches you with CONFIDENTIAL colleague with a similar job type as you
- **Interests** matches you with someone of similar interests to you, based on compatibility measures
- **Demographics** matches you with someone based on your age and gender preferences

Please select the option that you would prefer in the future:

Personal Vehicle Driver

Potential Financial Incentive	$0/day
Added Travel Time	0 min

Carpool Passenger

Potential Financial Incentive	$4/day
Added Travel Time	15 min
Matching Characteristics	Demographics

Carpool Driver

Potential Financial Incentive	$4/day
Added Travel Time	15 min
Matching Characteristics	Demographics

Transit Rider

Potential Financial Incentive	$6/day
Added Travel Time	30 min

Matching Characteristics:

- **Job Type** matches you with CONFIDENTIAL colleague with a similar job type as you
- **Interests** matches you with someone of similar interests to you, based on compatibility measures
- **Demographics** matches you with someone based on your age and gender preferences

Please select the option that you would prefer in the future:

Personal Vehicle Driver

Potential Financial Incentive	$0/day
Added Travel Time	0 min

Carpool Passenger

Potential Financial Incentive	$4/day
Added Travel Time	0 min
Matching Characteristics	Interests

Carpool Driver

Potential Financial Incentive	$2/day
Added Travel Time	15 min
Matching Characteristics	Random Associate

Transit Rider

Potential Financial Incentive	$8/day
Added Travel Time	20 min

Descriptive Characteristics

What is your gender?

Male

Female

What is your current age?

- < 25 years old
- 25 - 35 years old
- 36 - 45 years old
- 46 - 55 years old
- > 55 years old

Within what range is your yearly salary at CONFIDENTIAL?

- < $60,000
- $60,000 - $90,000
- $90,001 - $120,000
- $120,001 - $150,000
- $150,001 - $180,000

○ > $180,000

It would greatly enhance the effectiveness of this study if respondents would provide their home addresses. **This information will be kept completely confidential**. Please provide your home address below.

Address	
City	
State	
Postal code	

Will you please provide the name of an intersection close to your home?

Street 1:	
Street 2:	

Thank you for participating! If you have any further comments regarding commuting, please provide your feedback below:

Powered by Qualtrics

APPENDIX B

Parameters		Run A	T-stat	Run B	T-stat	Run C	T-stat	Run D	T-stat
-- Generic Parameters									
Incentive		0.171	10.29	0.1719	10.3	0.1705	10.3	0.1712	10.3
TT		-0.06	-9.02	-0.061	-9.02	-0.06	-9.01	-0.06	-9
Match_Demographics		0.3383	2.544	0.3377	2.52	0.3404	2.56	0.3384	2.55
Match_JobType		0.1339	0.968	0.1364	0.98	0.1346	0.97	0.1351	0.98
Match_Interests		0.2674	1.994	0.2665	1.97	0.2705	2.02	0.2678	2
-- Alternative Specific Parameters									
CONSTANT	Carpool_Driver	-2.169	-11.7	-0.876	-2.83	-1.754	-9.19	-1.834	-9.5
CONSTANT	Carpool_Passenger	-1.51	-9.79	-0.178	-0.75	-1.2	-7.77	-1.234	-7.7
CONSTANT	Transit_Rider	-0.593	-3.18	-0.646	-2.37	-0.043	-0.22	-0.002	-0
Male	Carpool_Driver	0.4969	2.918	--	--	--	--	--	--
Male	Carpool_Passenger	0.4397	3.553	--	--	--	--	--	--
Male	Transit_Rider	0.5981	4.704	--	--	--	--	--	--
Female	Carpool_Driver	--	--	--	--	--	--	-0.25	-1.5
Female	Carpool_Passenger	--	--	--	--	--	--	-0.189	-1.5
Female	Transit_Rider	--	--	--	--	--	--	-0.688	-5.4
Age	Carpool_Driver	--	--	-0.359	-4.1	--	--	--	--
Age	Carpool_Passenger	--	--	-0.381	-6.04	--	--	--	--
Age	Transit_Rider	--	--	0.0913	1.47	--	--	--	--
Salary	Carpool_Driver	--	--	--	--	--	--	--	--
Salary	Carpool_Passenger	--	--	--	--	--	--	--	--
Salary	Transit_Rider	--	--	--	--	--	--	--	--
Parking_Inf	Carpool_Driver	--	--	--	--	--	--	--	--
Parking_Inf	Carpool_Passenger	--	--	--	--	--	--	--	--
Parking_Inf	Transit_Rider	--	--	--	--	--	--	--	--
-- Model Statistics									
Log Likelihood at Zero		-2551		-2551		-2551		-2551	
Log Likelihood at Constants		-2298		-2298		-2298		-2298	
Log Likelihood at Convergence		-2184		-2167		-2183		-2183	
Rho Squared w.r.t. Zero		0.1438		0.1504		0.1442		0.144	
Rho Squared w.r.t Constants		0.0496		0.0569		0.05		0.0498	

Adjusted Rho Squared w.r.t. Zero	0.1395	0.1461	0.1399	0.1397
Adjusted Rho Squared w.r.t Constants	0.046	0.0533	0.0465	0.0463
Number of Cases	1840	1840	1840	1840
Number of iterations	6	6	10	6

Parameters		Run E	T-stat	Run F	T-stat	Run G	T-stat	Run H	T-stat
-- Generic Parameters									
Incentive		0.1703	10.26	0.1712	10.3	0.1706	10.3	0.1706	10.3
TT		-0.06	-8.99	-0.06	-8.99	-0.06	-8.99	-0.06	-9
Match_Demographics		0.3352	2.517	0.3332	2.5	0.3292	2.47	0.3402	2.55
Match_JobType		0.1347	0.974	0.1322	0.96	0.1306	0.94	0.1349	0.97
Match_Interests		0.2662	1.984	0.2656	1.98	0.2609	1.94	0.2677	1.99
-- Alternative Specific Parameters									
CONSTANT	Carpool_Driver	-1.615	-5.74	-1.843	-3.3	-2.728	-10.6	-1.114	-4.1
CONSTANT	Carpool_Passenger	-0.822	-3.8	-0.678	-1.68	-1.581	-8.33	-0.752	-3.5
CONSTANT	Transit_Rider	-0.356	-1.41	-1.955	-4.28	-0.278	-1.3	-0.015	-0.1
Male	Carpool_Driver	--	--	--	--	--	--	--	--
Male	Carpool_Passenger	--	--	--	--	--	--	--	--
Male	Transit_Rider	--	--	--	--	--	--	--	--
Female	Carpool_Driver	--	--	--	--	--	--	--	--
Female	Carpool_Passenger	--	--	--	--	--	--	--	--
Female	Transit_Rider	--	--	--	--	--	--	--	--
Age	Carpool_Driver	--	--	--	--	--	--	--	--
Age	Carpool_Passenger	--	--	--	--	--	--	--	--
Age	Transit_Rider	--	--	--	--	--	--	--	--
Salary	Carpool_Driver	--	--	--	--	--	--	-0.24	-3.9
Salary	Carpool_Passenger	--	--	--	--	--	--	-0.161	-3.7
Salary	Transit_Rider	--	--	--	--	--	--	-0.09	-2
Parking_Inf	Carpool_Driver	--	--	--	--	0.2843	4.16	--	--
Parking_Inf	Carpool_Passenger	--	--	--	--	0.0977	2.06	--	--
Parking_Inf	Transit_Rider	--	--	--	--	-0.031	-0.63	--	--

-- Model Statistics

Log Likelihood at Zero	-2551	-2551	-2551	-2551
Log Likelihood at Constants	-2298	-2298	-2298	-2298
Log Likelihood at Convergence	-2192	-2186	-2187	-2186
Rho Squared w.r.t. Zero	0.1405	0.143	0.1427	0.1428
Rho Squared w.r.t Constants	0.0459	0.0487	0.0484	0.0485
Adjusted Rho Squared w.r.t. Zero	0.1362	0.1387	0.1384	0.1385
Adjusted Rho Squared w.r.t Constants	0.0424	0.0452	0.0448	0.045
Number of Cases	1840	1840	1840	1840
Number of iterations	7	6	6	6

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